

DIVISION 5 SURFACE TREATMENTS AND PAVEMENTS**SECTION 5-01 SUBSEALING****5-01.1 DESCRIPTION**

Section 5-01 describes work consisting of filling voids under existing cement concrete pavement and rigid base asphalt pavements by pumping a mixture of Portland cement, pozzolan, or fly ash, and water under the pavement slabs.

5-01.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement and Pozzolan	9-01
Pozzolans	9-01.6(1) and 9-23.9
Water	9-25

5-01.3 CONSTRUCTION REQUIREMENTS**5-01.3(1) PROPORTIONING MATERIALS**

The standard mix design for subsealing is as follows:

1 part (by volume)	Portland cement Type I or II
3 parts (by volume)	pozzolan (natural or artificial)
2.25 parts (by volume)	Water

Any deviation from the above mix design shall be approved by the Engineer. The water content may be varied by the Contractor as required for local conditions.

5-01.3(2) EQUIPMENT

All equipment used in performance of subsealing shall be subject to the approval of the Engineer and shall be maintained in satisfactory working condition at all times.

Air compressors to be used for operating air hammers, and for blowing air into the cavities beneath the pavement, shall be of sufficient size and capacity for acceptable performance.

Air hammers shall be equipped with drills that are Capable of cutting 1-1/2 inch diameter holes through the pavement. The equipment shall be in good working condition and operated in such a manner that out-of-round holes shall not be produced.

The grout plant shall consist of a cement injection pump and a high speed colloidal mixing machine. The colloidal mixing machine shall operate at a minimum speed of 1,200 rpm and shall consist of a rotor operating in close proximity to a stator, creating a high shearing action and subsequent pressure release to make a homogeneous mixture.

The dry Material shall be accurately measured, and the water shall be batched through a meter or scale with a totalizer for the day's consumption.

Wooden cylindrical plugs or other devices approved by the Engineer shall be provided to temporarily plug the application holes until the Material has set. The plugs shall be slightly tapered on one end for ease in driving.

5-01.3(3) CONSTRUCTION

Subsealing shall not be done when the pavement is wet, or when water is present under the pavement. Application holes shall be drilled through the cement concrete pavement in the approximate pattern as indicated on the Drawings.

Application holes shall be approximately 1-1/2 inches in diameter and shall be perpendicular to the pavement surface. The Contractor shall not drill more holes in a day than can be filled or temporarily plugged during the same day. To prepare the cavity for injection of the subsealing mix Materials, compressed air shall be blown through the application holes for not less than 15 seconds and not more than 60 seconds. After the application holes are blown out and the nozzle is firmly wedged into the hole, the subsealing mix shall be pumped into the application hole until all cavities are filled, or until any one of the following occurs:

1. A pavement slab or portion of a slab starts to rise.
2. Subsealing mix extrudes from adjacent application holes, or along or outside the longitudinal edges of the pavement.
3. The Engineer orders application of subsealing mix stopped. Immediately upon removal of the nozzle, the plug shall be inserted and firmly driven into the application holes.

Following the application and after the mix has set, the wooden plugs shall be removed and the application holes immediately filled with subsealing mix.

Subsealing shall be continued progressively through the pavement requiring subsealing.

Traffic shall not be allowed upon any subsealed area until the subseal has hardened.

In the event the Engineer determines that continued injection at any specific location is no longer economically feasible, the Contractor shall cease operations and move to a new location.

5-01.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pavement Subseal" will be by the cubic foot of dry Materials used before the addition of water or other additives.

Measurement for "Drill Hole for Subsealing" will be by each hole drilled completely through the pavement.

5-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-01 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Drill Hole for Subsealing"**, per each.

The Bid item price for "Drill Hole for Subsealing" shall include all costs for the work required to drill the holes.

2. **"Pavement Subseal"**, per cubic foot.

The Bid item price for "Pavement Subseal" shall include all costs for the work required to complete the subsealing.

SECTION 5-02 BITUMINOUS SURFACE TREATMENT**5-02.1 DESCRIPTION****5-02.1(1) GENERAL**

Section 5-02 describes work consisting of constructing a single or multiple course bituminous surface by treating existing crushed rock, screened gravel or bituminous roadway surfaces with liquid asphalt and covering with a Mineral Aggregate thoroughly cemented to the roadway to obtain a wearing surface with good riding and nonskid qualities.

Roadway surfaces shall be classified as treated or untreated roadway surfaces as defined in Section 5-04.3(4)A.

Bituminous surface treatment method shall be Class B unless specified otherwise in the Contract.

Bituminous surface treatment shall not be considered "oil mat surface" (see Section 4-04).

5-02.1(2) BITUMINOUS SURFACE TREATMENT CLASS A

This method of treatment requires two applications of asphalt and three applications of aggregate. The second application (tack coat) shall be applied after the first application of prime coat has cured and all loose aggregate has been removed.

5-02.1(3) BITUMINOUS SURFACE TREATMENT CLASSES B, C, AND D

These methods require the placing of one application of asphalt and one or more sizes of aggregate as specified to an existing asphalt roadway to seal and rejuvenate the surface and to produce a uniform roadway surface with good nonskid characteristics.

5-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Asphalt	9-02
Anti-Stripping Additive	9-02.4
Mineral Aggregates	9-03

The grade of asphalt shall be Cationic Emulsified Asphalt (CRS-2) meeting the requirements of Section 9-02.1(6).

Mineral Aggregate for Bituminous Surface Treatment Class A or Class B shall be Mineral Aggregate Type 24, Chip Rock, meeting the requirements set forth in Section 9-03.

When cutback asphalts are specified for Bituminous Surface Treatment Class A, construction shall not begin until the need for anti-stripping additive has been determined. The Contractor shall allow a minimum of seven Working Days after the SPU Materials Laboratory has received samples of the Mineral Aggregate, asphalt, and anti-stripping additive, for testing. Additional time will be required by the Engineer to verify acceptable performance and compatibility, if the Contractor has requested more than one source of asphalt or anti-stripping additive be approved. The Contractor shall take this into consideration in preparing for and meeting Contract Time.

5-02.3 CONSTRUCTION REQUIREMENTS**5-02.3(1) EQUIPMENT**

The equipment used by the Contractor shall include scarifying, mixing, spreading, finishing and compacting equipment, an asphalt distributor, and equipment for heating asphalt Material, and shall be subject to approval by the Engineer before its use on the Work.

The distributor shall have a capacity of not less than 1,000 gallons, and shall be so designed, equipped, maintained, and operated that asphalt Material of an even heat shall be uniformly applied at the required rate. It shall be equipped with a 10-foot spray bar with extensions, pressure pump and gauge, volume gauge so located as to be observed easily by the Engineer from the ground, a tachometer to control accurately the speed and spread of asphalt, and two thermometers, one installed permanently in the tank to indicate temperatures of the asphalt at all times. The power for operating the pressure

pump shall be supplied by a power unit which provides a uniform spray from each of the nozzles across the spray bar and extensions.

Rollers shall be self-propelled pneumatic-tired or smooth-wheeled rollers, each weighing not less than 10 tons.

Spreading equipment shall be self-propelled, supported on at least four pneumatic tires, with an approved device for accurately metering and distributing the Mineral Aggregate uniformly over the roadway surface.

Brooms shall be motorized with a positive means of controlling vertical pressure.

Other equipment necessary to acceptably perform the work as specified herein shall be subject to approval by the Engineer before its use on the Work.

Additional units shall be placed on the Work when, in the opinion of the Engineer, it is considered necessary in order to fulfill the requirements of these Specifications, or to complete the Work within the time specified.

Both the asphalt distributor and the self-propelled chip spreader shall be calibrated prior to their use to ensure applications within the specified coverage limits. Adjustment of the asphalt distributor spray bar height shall produce a triple lap of spray fans from bars with a 4-inch nozzle spacing and a double lap from bars having a 6-inch nozzle spacing.

The Contractor shall frequently check and adjust, if necessary, the height of the spray bar during asphalt application to insure the height above the pavement surface does not vary more than 1 inch as the truck load lightens.

5-02.3(2) PREPARATION OF ROADWAY SURFACE

5-02.3(2)A UNTREATED SURFACES

Refer to Section 5-04.3(4)C.

No traffic will be allowed on the repaired surface until the prime coat of asphalt and Mineral Aggregate is applied.

5-02.3(2)B TREATED SURFACES

Refer to Section 5-04.3(4)B.

5-02.3(2)C SOIL RESIDUAL HERBICIDE

The use of soil residual herbicide will not allowed.

5-02.3(3) APPLICATION OF ASPHALT

Upon the properly prepared roadway surface, Cationic Emulsified Asphalt (CRS-2) shall be applied in non-shaded areas at the rate of 0.35 to 0.40 gallon per square yard, and in shaded areas at 0.38 to 0.45 gallon per square yard. The asphalt spraying application temperature at the distributor shall be between 140°F and 185°F. The Engineer may vary the rate of asphalt application that will give the best results.

To ensure uniform distribution of asphalt prior to beginning the asphalt application, the distributor bar shall be operated over a pit or vat. To avoid gaps and ridges at transverse junctions of separate applications of asphalt, the Contractor shall spread sufficient building paper over the treated surface to make sure that the spray jets function normally when the untreated surface is reached.

The pattern of application of shots, and width and length of application of shots of asphalt Material shall be such as to provide proper coverage of crushed Material within the times specified, provide proper widths to such dimensions as to facilitate an acceptable coverage of crushed cover stone, and provide lapping of subsequent adjacent applications.

Asphalt shall be applied to spandrels of intersections and driveways immediately ahead of, or immediately behind the adjacent longitudinal street application.

Omissions (skips) by the distributor shall immediately be covered by hand application with the same grade of hot asphalt.

Any one spread of asphalt shall cover no more area than can be covered with Mineral Aggregate within 3 minutes from the time of application, upon any part of the spread.

Asphalt shall be spread toward the source of Mineral Aggregate to avoid injury to the freshly treated surface. No asphalt shall be spread until adequate supplies of Mineral Aggregate are on hand at the Project Site.

Where earth curbs or no curbs exist, the application of asphalt shall extend 4 inches beyond the gutter line. Where concrete curb and gutter exist, the application shall lap onto the gutter section, but shall not exceed 2 inches. Where concrete curb exists, the application shall be placed as closely as possible to the vertical surface without excessive splash onto the curb. Where concrete curb or curb and gutter exist, the distributor shall be equipped with a splash board designed to prevent spraying thereon.

All castings shall be protected by securely covering with heavy building paper and weighing down with sand or crushed Material.

Hand sprayers shall be used to apply asphalt around castings, and to areas where coverage is insufficient.

5-02.3(4) CHANGE IN GRADES OF ASPHALT

At any time during the progress of the asphalt construction, the Engineer may order the use of other grades of asphalt Materials in substitution of the grades specified in the Contract if the intent of the Specifications will be better attained.

5-02.3(5) APPLICATION METHOD OF AGGREGATES

Any method of handling the Mineral Aggregate which causes segregation of the various sizes of aggregate particles shall be corrected by the Contractor upon the request of the Engineer so that a uniform product is incorporated in the Work.

After applying the asphalt uniformly over the roadway surface, Mineral Aggregate of the Type specified shall be uniformly applied to the roadway surface at a rate of 25 to 33 pounds per square yard by spreader equipment. The quantity of Mineral Aggregate to be applied shall be such that the asphalt shall be uniformly covered and shall not pick up under traffic. The Mineral Aggregate shall be uniformly applied over the freshly spread asphalt by trailer-type or self-propelled spreader boxes. The Mineral Aggregate shall be applied so that trucks and spreader boxes do not travel on the fresh asphalt and the Mineral Aggregate layer shall be spread in one operation for each application of asphalt. Spandrels of intersections, driveways, and bare spots shall be covered by hand spreading from trucks immediately behind the box application. Mineral Aggregate shall be spread in such a manner as to provide an 8-inch strip of asphalt exposed to provide a lap with the next application of asphalt.

The Mineral Aggregate shall be damp and shall be free of dust and impurities, when applied to the roadway. If the Mineral Aggregate is dry or dusty or both dry and dusty, the Contractor shall spray the aggregate with water to obtain a damp and dust free condition. Dusty or dry Mineral Aggregate which compromises adhesion of the Mineral Aggregate to the substrate will not be allowed.

As soon as the aggregate has been applied to the surface, the aggregate shall be well rolled with a self-propelled pneumatic-tired roller. Places inaccessible to the pneumatic-tired roller, such as spandrels of intersections and private driveways, shall be rolled with a self-propelled smooth-wheel roller.

Where excess Mineral Aggregate has been applied, it shall either be removed or be drifted uniformly over the adjacent roadway by using a motor patrol grader equipped with a wire broom mold board, subject to approval of the Engineer. This type of brooming shall be held to a minimum, and where necessary it shall be very carefully performed so as not to disturb the mat in any way. Thin or bare spots in the spread of Mineral Aggregate shall be corrected by hand spreading or by use of a grader as described above.

Rolling and brooming shall continue until the roadway is uniformly covered and the Mineral Aggregate is well compacted and "set" into the asphalt. This operation shall continue until the asphalt has cured to the extent that it does not "pick up" under traffic. During the maintenance period following the application of the Bituminous Surface Treatment, the Contractor shall perform brooming, spotting, and rolling as necessary to prevent "pick up" or other damage to the surface.

At any time during the progress of the Work, the Engineer may order the use of a different Mineral Aggregate grading in lieu of the Mineral Aggregate specified if in the Engineer's judgment the results contemplated by the Specifications will thereby be better attained.

5-02.3(6) ADDITIONAL ASPHALT AND MINERAL AGGREGATE

If the application of asphalt or Mineral Aggregate, or both, is insufficient or excessive for the required results, the Engineer may require the Contractor to make an additional application of one or both Materials in accordance with these Specifications.

5-02.3(7) PATCHING AND CORRECTION OF DEFECTS

Omissions by the distributor or damage to the treated surface of any coat shall be immediately covered by hand application with asphalt in adequate quantities. Holes which develop in the surface shall be patched in the same manner as specified in Section 5-04.3(4)C2.

Defects such as raveling, lack of uniformity, or other imperfections caused by faulty workmanship shall be corrected and new work shall not be started until such defects have been remedied.

All improper workmanship and defective Materials resulting from overheating, improper handling or application, shall be removed from the roadway by the Contractor and shall be replaced with approved Materials and workmanship.

If the Engineer determines a fog seal is necessary at any time during the life of the Contract, the Contractor shall apply a fog seal of CSS-1 at the rate of 0.07 to 0.18 (0.02 to 0.05 residual) gallons per square yard. The emulsified asphalt shall be diluted with water at a rate of one part water to one part emulsified asphalt.

5-02.3(8) PROGRESS OF WORK

The Contractor shall organize the entire operation ensuring progression in an orderly and expeditious manner.

The sequence of operation for placing Bituminous Surface Treatments shall be as follows:

1. Apply asphalt emulsion on a properly prepared roadway surface resulting in a uniform application.
2. Apply Mineral Aggregate by spreader boxes or other means resulting in a uniform application.
3. Roll with pneumatic-tired and/or self-propelled smooth-wheeled roller.
4. Allow a minimum of 48 hours set time.
5. Sweep with an approved road broom to pick up and remove excess Mineral Aggregate. This work shall be accomplished in the early morning hours before the heat from the sun has warmed the pavement.
6. Maintain roadway surface for 5 calendar Days by sweeping and patching as necessary on a daily basis, maintaining traffic signing, etc.

Ten (10) Calendar Days after the final application, the Contractor shall make a final sweep with a mechanical broom, using the pick up broom only, to clear off any remaining loose aggregates. Gutter brooms shall not be used. The Contractor shall dispose of the excess Mineral Aggregates.

5-02.3(9) PROTECTION OF STRUCTURES

All handrails, guardrails, curbs, road signs, and other facilities shall be protected from splashing and overspray.

5-02.3(10) UNFAVORABLE WEATHER

Asphalt shall not be applied to excessively wet Material. Asphalt shall not be applied during rainfall, sand or dust storms, or before any imminent storms that might adversely impact the construction. The Engineer will determine whether the surface and Materials are acceptable for the construction in inclement weather.

The application of any asphalt to the roadway shall be restricted to the following conditions:

1. The roadway surface temperature shall be at least 60°F and the air temperature at least 60°F and either holding or rising, or
2. The air temperature shall be not less than 70°F when falling and the wind shall be less than 10 miles per hour as estimated by the Engineer.

No asphalt shall be applied which cannot be covered one hour before darkness. The Engineer may require the Contractor to delay application of asphalt until the atmospheric and roadway conditions are within the conditions listed above.

Construction of bituminous surface treatments on any Traveled Way shall not be carried out before May 15 or after September 1 of any year except upon written notice from the Engineer.

5-02.3(11) ANTI-STRIPPING ADDITIVE

When directed by the Engineer, an anti-stripping additive shall be added to the asphalt Material (see Section 9-02.4).

5-02.3(12) UNTREATED ROADWAY SURFACES

Existing crushed rock, gravel, and oil mat streets shall be restored with Mineral Aggregate Type 1, to a compacted depth of 4 inches. Final surfacing shall be constructed as specified in Section 5-04.3(4)C2.

5-02.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Asphalt (Grade)" will be made by the gallon or ton before dilution.

Measurement for Mineral Aggregate Type will be by the ton.

Measurement for roadway preparation will be as specified in Section 5-04.4

5-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Asphalt, (Grade)"**, per gallon or ton.

The Bid item price for "Asphalt, (Grade)" shall include all costs for the work required to construct a single or multiple course bituminous surface treatment.

2. **Other payment information.**

Payment for Mineral Aggregate (Type) will be made in accordance with Section 4-01.5.

Change in Mineral Aggregate Type, or in grade of asphalt, or in Engineer directed application of fog seal will be addressed in accordance with Section 1-04.1(2).

All costs for the work required to coat omissions or to patch defects shall be included in the Bid item price for the applicable Bid item.

All costs for splashing and overspray protection shall be included in the Bid item price for the applicable Bid item.

All costs for roadway preparation will be paid in accordance with Section 5-04.5.

All costs for water will be paid in accordance with Section 2-07.5.

SECTION 5-03 RESERVED**SECTION 5-04 HOT MIX ASPHALT (HMA) PAVEMENT****5-04.1 DESCRIPTION**

This work shall consist of providing and placing one or more layers of plant-mixed hot mix asphalt (HMA) on a prepared foundation or base in accordance with these Specifications and the lines, grades, thicknesses, and typical cross-sections shown on the Drawings.

HMA shall be composed of asphalt binder and Mineral Aggregate as may be required, and then mixed in the proportions specified to provide a homogeneous, stable, workable, and compactable mixture.

5-04.2 MATERIALS

Materials shall meet the requirements of the following sections:

Bituminous Materials	9-02
Mineral Aggregates	9-03

Temporary Pavement Marking 9-29.4

The grade of asphalt binder will be specified in the Contract (also see Section 5-04.2(1)).

5-04.2(1) USE OF SUBSTITUTE MATERIALS

The proposed use of substitute or alternate materials by the Contractor in the production of HMA from those specified in the Contract shall be part of the submittal as specified in Section 5-04.3(6) and shall require approval of the Engineer.

Recycled asphalt pavement (RAP): Unless the Contract specifies otherwise, the Contractor may propose the use of RAP (see Section 9-03.8(3)B). RAP shall not exceed 20% of the total weight of aggregate in the HMA mix. RAP will not be allowed for asphalt binders with grades of PG-70 or higher.

Grade of asphalt binder: Unless the Contract specifies otherwise, the Contractor may propose the use of a substitute grade of asphalt binder. The substitute grade of asphalt binder shall:

1. meet the requirements of Section 9-02.1(4),
2. have a maximum pavement design temperature that is equal to or greater than that of the specified binder, and
3. have a minimum pavement design temperature that is equal to or lower than that of the specified binder.

The Engineer approved substituted grade of asphalt binder shall be used only in HMA of the same class with the Contract-specified grade of asphalt binder. Blending of asphalt binder, whether different manufacturers and/or Suppliers and/or different grades, will not be permitted.

5-04.3 CONSTRUCTION REQUIREMENTS**5-04.3(1) TERMS RELATED TO HMA**

In Sections 5-04, 9-02, 9-03.6, and 9-03.8, terms and phrases used (such as "design aggregate structure", "nominal maximum aggregate size", "air voids", "maximum aggregate size", "binder content", etc.) and abbreviations (such as "JMF" for "job mix formula", "V_a", "N_{design}", "G_{sb}", etc.) are consistent with and can be found in WSDOT Standard Operating Procedure (SOP) 732 "Volumetric Design for Hot-Mix Asphalt (HMA)" and such other documents that are incorporated by reference within WSDOT SOP 732. WSDOT SOP 732, and other incorporated by reference documents, are available in the current edition of the Washington State Department of Transportation's Materials Manual M 46-01.

5-04.3(2) MIXING PLANT

In addition to the requirements of Section 1-06, the Contractor shall allow the Engineer safe access to stockpiles for sampling. An adequate and convenient space for the Engineer to temporarily store and test samples shall be allowed.

Plants used for the preparation of HMA shall conform to the following requirements:

Equipment for Preparation of Asphalt Binder: Tanks for the storage of asphalt binder shall be equipped to heat and hold the binder at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the storage tank. The circulating system for the asphalt binder shall be designed to ensure proper and continuous circulation during the operating period. A valve for the purpose of sampling the binder shall be placed in either the storage tank or in the supply line to the mixer. Also see Section 5-04.3(5) for heating asphalt binder additional requirements.

Thermometric Equipment: An armored thermometer, Capable of detecting temperature ranges expected in the HMA mix, shall be fixed in the asphalt feed line at a location near the charging valve at the mixer unit. The thermometer location shall be convenient and safe for observation by the Engineer.

The plant shall also be equipped with an approved dial-scale thermometer, a mercury actuated thermometer, an electric pyrometer, or another approved thermometric instrument placed at the discharge chute of the drier to automatically register or indicate the temperature of the heated aggregates. This device shall be in full view of the plant operator and shall be convenient to observation by the Engineer.

Sampling and Testing of Mineral Aggregates: The HMA plant shall be equipped with a mechanical sampler for the sampling of the Mineral Aggregates by the Engineer (see Sections 1-06.1 and 1-06.2).

5-04.3(3) PAVING AND RELATED EQUIPMENT**5-04.3(3)A HAULING EQUIPMENT**

Trucks used for hauling HMA shall have tight, clean, smooth metal beds. A cover fabricated of canvas or other suitable material and of sufficient size to completely protect the mixture from adverse weather shall be securely attached to the truck. Whenever the weather conditions during the workshift include, or are forecast to include, precipitation or an air temperature less than 45° F, the cover shall be securely attached to protect the HMA.

In order to prevent the HMA mixture from adhering to the hauling equipment, truck beds shall be sprayed with an environmentally benign release agent. Excess release agent shall be drained prior to filling with HMA. For hopper trucks, the conveyor shall be in operation during the process of applying the release agent.

5-04.3(3)B PAVING EQUIPMENT**5-04.3(3)B1 GENERAL**

As specified in Section 1-05.9, the Contractor shall replace equipment producing defective work.

When requested by the Engineer, the Contractor shall be prepared to timely provide HMA and related equipment manufacturer's written operating instructions and maintenance manual.

5-04.3(3)B2 HMA PAVERS

HMA pavers shall be self-contained, power-propelled units, provided with an internally-heated vibratory screed or strike-off assembly and shall be Capable of spreading and finishing courses of HMA plant mix material in lane widths specified on the Drawings.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, segregating, or gouging the HMA. Extensions will be allowed provided they produce the same results, including ride, density, and surface texture as obtained by the primary screed or strike off assembly. Extensions without augers, vibration, and heated screeds, shall not be used in the traveled way.

The paver shall be equipped with automatic screed controls with sensors for either or both sides of the paver. The controls shall be Capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing automatic signals that operate the screed to maintain the desired grade and transverse slope. The sensor(s) shall be constructed so it operates from a reference line or a mat referencing device.

The Contractor shall furnish and install all pins, brackets, tensioning devices, wire, and accessories necessary for satisfactory operation of the automatic control equipment. The Contractor shall be prepared to provide samples of the above items prior to installation when requested by the Engineer.

The transverse slope controller shall be Capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. The paver shall be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

Pavers operating with an MTV shall have additional capacity as specified in Section 5-04.3(3)B3.

5-04.3(3)B3 MATERIAL TRANSFER VEHICLES (MTV)

An MTV shall be an independent, self-powered device configured for transferring HMA from hauling equipment to the paver. An MTV shall also have the following characteristics:

Delivery System: The MTV shall have a high capacity truck unloading system that receives HMA from the hauling equipment. The truck unloading systems shall be Capable of unloading a truck at a rate greater than the rate of placement by the paver.

Surge Capacity: The MTV shall be equipped with an integral storage bin Capable of holding 25 tons of HMA. In addition, the HMA paver operating with an MTV shall be equipped with a hopper insert that shall be able to contain 15 additional tons of HMA.

Remixing Equipment: The MTV shall be designed to provide HMA remixing prior to discharging to the paver.

Discharge Conveyor: The MTV shall be equipped with a discharge conveyor that shall have the ability to swivel so the MTV may be operated from an adjacent lane while delivering HMA to the paver.

5-04.3(3)C ROLLERS

Rollers shall be of the steel wheel, vibratory or pneumatic tire type, in good condition and Capable of reversing without backlash. Operation of the roller shall be in accordance with the manufacturer's recommendations. The number and weight of rollers shall be sufficient to compact the mixture in compliance with the requirements of Section 5-04.3(9). The use of equipment that results in crushing of the aggregate will not be permitted. Rollers producing pickup, washboard, uneven compaction of the surface, displacement of the mixture, or other defective work (see Section 1-05.7) will be rejected by the Engineer in accordance with Section 1-05.9.

5-04.3(3)D PLANING BITUMINOUS PAVEMENT AND REQUIRED PRE-PANING METAL DETECTION

5-04.3(3)D1 GENERAL

Prior to planing, the Contractor shall meet with the Engineer to discuss the planing operations as specified in Section 5-04.3(17).

5-04.3(3)D2 PLANING BITUMINOUS PAVEMENT

Planing bituminous pavement shall be by the cold planing method only. Equipment shall be of a type that has operated successfully on work comparable to that in the Contract and shall be subject to the Engineer's approval prior to use. Equipment shall be maintained in good working condition while in use.

Cold planers shall be milling type equipment Capable of cutting at least a 5 foot chord to a depth of up to four (4) inches in one pass. For Contract or Engineer required planing depths in excess of four inches and as the total depth requires, the first pass and all succeeding passes shall each be to a maximum four inch depth, with the final pass depth being four or fewer inches to achieve the total depth. Smaller planers may be used for cutting around castings and other metal objects to remain, and for making taper cuts for butt joints.

Where metal is not visible on the surface but is detected below the surface, the Contractor shall employ methods of pavement removal that do not damage the detected metal if it is to remain, and is beyond the 4 inch maximum depth of planing so as not to damage Contractor equipment. On areas where irregularities or unavoidable obstacles make the use of mechanical planing equipment impractical, the planing shall be done with other equipment or by other means.

For mainline cold planing operations, the equipment shall have automatic controls with sensor for either or both sides of the equipment Capable of sensing the proper grade from an outside reference line. The automatic controls shall also be

Capable of maintaining the desired transverse slope. The sensor shall be so constructed that it operates from a reference line or multi-footed ski-like arrangement. The transverse slope controller shall be Capable of maintaining the desired slope within plus or minus 0.1 percent.

5-04.3(3)D3 REQUIRED PRE-PLANING METAL DETECTION

The Contractor shall be aware that metal may be buried beneath the existing asphalt surface. Such metal may be rail track associated with Seattle's former street car system, or may be castings buried under asphalt overlay, or other similar metallic items.

Before planing, the Contractor shall adequately sweep the entire area of asphalt to be planed to detect buried metal.

If such metal is detected and is not indicated in the Contract, the Contractor shall surface mark such detected metal and shall notify the Engineer of such condition before planing as required by Section 1-04.7.

Where the Drawings indicate the existence of metal not visible on the existing pavement surface, the Contractor shall remove such surface pavement material and verify the depth to metal before planing. If the depth to metal is beyond the required depth of planing, the Contractor shall note such and shall avoid planing contact with such metal. If the depth to metal is within the depth range of required planing, then one of two outcomes is required, as follows:

1. If a metal casting, then the casting shall be treated as specified in Section 7-20.
2. If a metal object other than a casting, then the Engineer may require removal. If removal is not addressed in the Contract, then this portion of work will be addressed as extra work.

Metal detection equipment shall have adequate sensitivity to detect metal hidden beneath existing pavement surface to a depth of at least 4 inches. Where planing is indicated to a depth greater than four inches, the Contractor shall be prepared to make multiple planing passes with each pass not exceeding the four inch depth. Before each planing pass of four inch or less, the Contractor shall resweep the same area of asphalt to detect metal.

Where the Engineer directs additional depth planing beyond that required in the Contract, the Contractor shall again sweep for metal before such additional depth planning, as described in this Specification.

Contractor planing equipment damaged by metal buried within asphalt shall be the sole responsibility of the Contractor.

5-04.3(4) PREPARATION OF STREET SURFACES

5-04.3(4)A PREPARATION CLASSIFICATION DESCRIPTIONS

In preparing surfaces, the following surface classifications apply:

Treated surfaces: cement concrete, asphalt concrete, brick, seal coat or other bituminous surface treatments.

Untreated surfaces: crushed rock, gravel, native subgrade, or oil mat surfaces.

Bituminous surface treatments are addressed in Section 5-02, and oil mat surfaces are addressed in Section 4-04.

The work of preparing existing surfaces for asphalt concrete or other bituminous Material overlay shall be classified as follows:

"Surface preparation" applies only to treated surfaces, and

"Roadway preparation" applies only to untreated surfaces.

5-04.3(4)B SURFACE PREPARATION – TREATED SURFACES

5-04.3(4)B1 GENERAL

When an existing treated surface is to be used as a base for one or more courses of new asphalt concrete, or other surfacing (see Sections 4-04 and 5-02), the treated surface shall first be swept, cleaned, and patched as follows:

1. Treated surfaces shall be swept with a power broom until free from dirt and other foreign matter. Hand brooms shall be used to clean omissions of the power broom. Fatty asphalt patches, grease drippings and other objectionable Material shall be removed from the existing pavement.
2. Excess asphalt joint filler shall be completely removed and premolded joint filler shall be removed to at least 1/2-inch below the surface of the existing pavement.
3. In order to obtain a sound base having uniform grade and cross section, irregularities in the existing treated surface shall be corrected prior to placement of the new asphalt concrete or other bituminous surface treatment. Corrections shall be made by planing, preleveling, grinding, patching or by placing new base pavement.

5-04.3(4)B2 PRELEVELING

When a surface of the existing pavement or old base is irregular, it shall be brought to a uniform grade and cross section by preleveling. Existing surfaces not requiring planing, but requiring other repair or requiring preleveling, will be addressed in the Contract. If existing asphalt overlay is planed and the surface to remain requires preleveling, then the Engineer will direct preleveling before HMA wearing course placement in accordance with Section 5-04.3(8). As soon as the existing surface has been thoroughly cleaned, holes and discontinuities in the surface and edges and edge breaks shall be repaired as specified in the Contract. Patching shall be accomplished prior to preleveling or installation of the first asphalt course, whichever is applicable.

Preleveling Materials shall be the same HMA class of asphalt concrete as the wearing course or an acceptable alternate approved by the Engineer. If the Contract does not require a finish HMA wearing course, then the preleveling of uneven or broken surfaces shall be accomplished by placing asphalt concrete of the class specified with a motor patrol grader, by hand-raking, by Miller box, or by such other method acceptable to the Engineer.

After placement, the preleveling Material shall be thoroughly compacted with a pneumatic tire roller unless alternate equipment is approved by the Engineer.

When planing is not a Bid item in the Contract, the Contractor shall be prepared to spot grind occasional high areas caused by rutting, etc., to a depth to allow for a uniform application of preleveling.

5-04.3(4)B3 PLANING BITUMINOUS PAVEMENT

5-04.3(4)B3a PRE-PLANING METAL DETECTION CHECK

Before beginning planing of pavements, and before any additional depth planning when directed by the Engineer, the Contractor shall conduct a physical survey of existing pavement to be planed with equipment that can identify hidden metal objects.

Should such metal be identified, the Contractor shall promptly bring this to the attention of the Engineer.

See Section 1-07.16(1) regarding the protection of survey monumentation that may be hidden in pavement.

Any damage to equipment resulting from the Contractor's failure to conduct a pre-planing metal detection survey, or from the Contractor's failure to bring to the attention of the Engineer any hidden metal that is detected, shall be the Contractor's sole responsibility.

Also see Section 5-04.3(17) regarding a planing plan and pre-planing briefing prior to beginning planing.

5-04.3(4)B3b PLANING

See Section 5-04.3(17) regarding a planing plan, and pre-planing briefing prior to beginning planing.

Locations of existing surfacing to be planed will be indicated in the Contract.

Where planing an existing pavement is specified in the Contract, the Contractor shall be prepared to both remove existing surfacing material, and to reshape a surface to remove irregularities. The finished product shall be a prepared surface acceptable for receiving an HMA overlay.

Planing shall be by the cold milling method unless otherwise specified in the Contract. The planer shall not be used on the final wearing course of new HMA.

Planing operations shall be conducted in a manner that does not tear, break, burn, or otherwise damage the surface which is to remain. The finished planed surface shall be slightly grooved or roughened and shall be free from gouges, deep grooves, ridges, or other imperfections. Repair of the surface to remain that is damaged by the Contractor's planing shall be by a method acceptable to the Engineer.

Metal castings and other surface improvements damaged by planing shall be repaired or replaced as determined by the Engineer.

A tapered wedge cut shall be planed longitudinally along curb lines sufficient to provide a minimum of 4 inches of curb reveal after placement and compaction of the final wearing course. The dimensions of the wedge shall be as shown on the Drawings or as specified by the Engineer.

A tapered wedge cut shall also be made at transitions to adjoining pavement surfaces (meet lines) where butt joints are indicated on the Drawings. Butt joints shall be cut in a straight line with vertical faces 2 inches or more in height and shall produce a smooth transition to the existing adjoining pavement.

After planing is complete, the planed surfaces shall be swept, cleaned, and if required by the Contract, patched and preleveled.

The Engineer may direct additional depth planing. Prior to performing this additional depth planing, the Contractor shall first conduct a hidden metal in pavement detection survey as required in Section 5-04.3(4)B3a.

5-04.3(4)B4 TACK COAT AND DISTRIBUTOR EQUIPMENT REQUIREMENTS

5-04.3(4)B4a TACK COAT REQUIREMENT

Tack coat shall be CSS-1, CSS-1h, or STE-1 emulsified asphalt. The CSS-1 and CSS-1h emulsified asphalt may be diluted with water at a rate not to exceed one part water to one part emulsified asphalt. The emulsified asphalt shall not exceed the maximum temperature recommended by the emulsified asphalt manufacturer.

A tack coat of asphalt, applied at the rate of 0.02 to 0.08 gallons per square yard of retained asphalt, shall be applied to all paved surfaces on which any course of HMA is to be placed or abutted. The tack coat shall cover the existing pavement uniformly with a residual asphalt film free of streaks and bare spots. Tack coat shall only be applied to surfaces that are dry and free from moisture. Tack coat shall not be applied under the imminent threat of rain as determined by the Engineer.

The Contractor shall make arrangements with the Engineer demonstrating tack coat application at the beginning of such application. Once the Engineer approves the tack coat application method and rate of application, the Contractor shall continue with such application without exception.

Where the new asphalt concrete abuts a curb or gutter, cold pavement joint, trimmed meet line, or any metal surface, tack coat of asphalt shall be applied on the vertical face of the abutting surface. The application on the contact surfaces shall be uniform in order to avoid an accumulation of excess asphalt. Excess tack coat shall be immediately removed. The

Contractor shall not apply the tack coat on vertical contact surfaces above the finished height of the asphalt concrete being placed.

Tack coat shall be applied only to surfaces to receive tack coat treatment, and shall not be applied to any other surface. Tack coat applied to surfaces not to be coated shall require immediate removal of the tack coat, including thorough cleaning of the surface area as may be reasonably necessary for leaving no residue.

Equipment shall not operate on tacked surfaces until the tack has broken and cured. If the Contractor's operation damages the tack coat it shall be repaired prior to placement of the HMA. For surfaces open to traffic, the application of tack coat shall be limited to surfaces that will be paved during the same working shift.

5-04.3(4)B4b DISTRIBUTOR EQUIPMENT REQUIREMENT

The distributor equipment shall be Capable of distributing a uniform tack coat in controlled amounts.

The distributor shall have a capacity of not less than 1,000 gallons, and shall be so designed, equipped, maintained, and operated that asphalt Material of an even heat shall be uniformly applied at the required rate.

The power for operating the pressure pump shall be supplied by a power unit which provides a uniform spray from each of the nozzles across the spray bar and extensions.

In addition, the distributor shall be equipped with the following:

1. a thermometer to indicate the temperature of the tack coat material,
2. a thermometer installed permanently in the tank to indicate temperatures at all times,
3. hand operated spray equipment for use only on inaccessible and irregularly shaped areas,
4. a 10-foot spray bar with extensions,
5. pressure pump and gauge, and volume gauge so located as to be observed easily by the Engineer from the ground, and
6. a tachometer to control accurately the speed and spread of asphalt.

The Engineer may allow hand operated spray equipment separate from the distributor equipment for inaccessible and irregularly shaped areas if the Contractor can demonstrate acceptable tack coat application.

5-04.3(4)C SURFACE PREPARATION OF UNTREATED SURFACES

5-04.3(4)C1 GENERAL

Untreated roadway surfaces, including intersections and side roadway approaches which are to receive asphalt concrete pavement, or other surfacing (see Sections 4-04 and 5-02), shall be shaped to a uniform grade and cross-section, conforming as nearly as possible to that which exists except:

Where new lines and grades are indicated in the Contract or staked by the Engineer.

The basis for establishing final line and grade in such cases shall be curbs, curbs and gutters, existing pavement, or pavement edges or other existing street improvements. Existing driveways shall be graded as necessary to provide a smooth transition to the final grade of the new pavement surface including such grading as may be necessary to permit driveway adjustment.

Where no curbs or curbs and gutters exist and where none are required by Contract, subgrade preparation shall extend one foot on each side of the roadway beyond the final asphalt paving width indicated on the Drawings. The Contractor shall be prepared to extend this subgrade preparation to such greater width as the Engineer may require to accommodate local conditions such as intersections.

The grade shall be shaped so that all frame castings for manholes, monument boxes, gate valve boxes, catch basins, etc. within the roadway section to be treated, extend above the prepared surface, and such that all castings are flush with the final wearing course. Where existing asphalt or Portland cement concrete pavement is being met with new asphalt surfacing, sufficient existing untreated surfacing shall be removed to permit the forming of a butt joint. The completed finish surface, including castings and transitions with existing treated surfaces, shall be smooth as specified in Section 5-04.3(12).

Those areas and surfaces which are to be prepared for the placement of asphalt concrete pavement or other surfacing shall be considered Subgrade for the new construction. See Section 2-06 for subgrade preparation requirements. Excess native material deemed suitable by the Engineer shall be considered selected Material per Section 2-03.3(10) and shall be stockpiled by the Contractor or bladed to the roadway edge and used as needed for fill or shoulder restoration following completion of the paving. The selected Material shall be used to the fullest extent possible as sub-base Material prior to the placement of new crushed rock.

Water shall be available on site and shall be applied as necessary to meet compaction requirements and to alleviate dust.

Excess material shall be disposed of.

5-04.3(4)C2 PRIME COAT TREATMENT

Where required in the Contract, a prime coat treatment of asphalt complying with the requirements of Section 5-02.3(3) for existing gravel, crushed rock, or oil mat streets shall be applied prior to paving with asphalt concrete. The prime coat shall be applied over the entire area of proposed asphalt pavement construction. Following the application of the prime coat, HMA shall not be placed until the prime coat has cured.

In the event the surface receiving the prime coat is of such gradation and relative density as to resist penetration of the prime coat, the Contractor shall immediately before application of the prime coat, loosen no more than the upper 1/2 inch of surface and regrade it without compaction.

The Contractor shall maintain the completed prime coat by blading or brooming until the asphalt concrete is placed. Should any holes, breaks, or irregularities develop in the roadway surface after the prime coat has been applied, such defects shall be patched or repaired in accordance with Section 5-04.3(4)C1 immediately in advance of placing the asphalt concrete pavement.

Immediately prior to placing the HMA, the surface of the prime coat shall be swept clean of all dirt, dust, and other foreign matter.

5-04.3(4)D CRACK SEALING

Where the Contract requires "Crack Sealing", all cracks and joints shall be cleaned with a stiff-bristled broom and compressed air. Loose pieces shall be removed and disposed of.

After cleaning, all cracks less than 1/4 inch in width shall be filled with straight CSS-1 emulsified asphalt and topped with sand.

After cleaning, all cracks and joints at least 1/4 inch or greater in width, shall be filled with sand slurry.

Rubberized asphalt shall be used where specified in the Contract.

The Contractor may request substitution of rubberized asphalt for sand slurry; however, such request requires written approval from the Engineer before use. Rubberized asphalt shall not be used to seal cracks greater than 1-1/2 inches in width.

Application of the sand slurry or rubberized asphalt shall be as follows:

1. Sand Slurry: The sand slurry shall consist of 20 percent CSS-1 emulsified asphalt, 2 percent Portland cement, sufficient water for workability, and the remainder clean U.S. No. 40 paving sand. The components shall be thoroughly mixed and poured into the cracks and joints until full. The following day, any cracks or joints that are not completely filled shall be topped off with additional sand slurry. After the sand slurry is placed, the filler shall be struck off flush with the existing pavement surface and allowed to cure. The HMA overlay shall not be placed until the slurry has fully cured.

2. Rubberized Asphalt: The sealant Material shall meet the requirements of Section 9-04.10 and shall be applied in accordance with the sealant manufacturer's recommendations. These recommendations shall be submitted to the Engineer by the Contractor prior to the start of this type construction and shall include recommended heating time and temperature, allowable storage time and temperatures after initial heating, allowable reheating criteria, and application temperature range. The cracks shall be completely dry before being filled with the rubberized asphalt. Filling shall be controlled to confine the Material within the crack or joint. Where the sealed cracks are to be overlaid with asphalt, the sealant shall be recessed 3/8 inch below the surface. The Contractor's method of sealant application shall confine the sealant to the crack or joint and shall not result in any spillage on the pavement surface.

Should spillage occur, the Contractor shall have readily available, Supplies and as necessary to timely and effectively remove sealant over-application.

5-04.3(5) HEATING OF ASPHALT BINDER

The temperature of the asphalt binder shall not exceed the asphalt binder manufacturer's recommended maximum temperature at any time, and shall not fall below the minimum temperature recommended by the asphalt binder manufacturer. The asphalt binder shall be heated in a manner that prevents local variations in heating. The heating method shall provide a continuous supply of asphalt binder to the mixer at a uniform average temperature with no individual variations exceeding 25°F. Also see Section 5-04.3(2) regarding HMA mixing plant requirements.

5-04.3(6) HMA MIX DESIGN AND SUBMITTAL REQUIREMENTS

5-04.3(6)A PREPARATION OF AGGREGATES

Sufficient storage space shall be provided for each size of aggregate. The aggregates shall be removed from stockpile(s) in a manner to ensure a minimum of segregation when being moved to the HMA plant for processing into the final mixture. Different aggregate sizes shall be kept separated until they have been delivered to the HMA plant.

5-04.3(6)B MIX DESIGN

5-04.3(6)B1 GENERAL

From the stockpiled aggregates to be used in the production of HMA, the Contractor shall determine a design aggregate structure and asphalt binder content in accordance with WSDOT Standard Operating Procedure 732, "Volumetric Design for Hot-Mix Asphalt (HMA)", available in the current edition of the Washington State Department of Transportation's Materials Manual M 46-01. The grade of asphalt binder shall be as specified in the Contract (also see Section 5-04.2(1) where binder substitution is allowed). The nominal maximum aggregate size and design ESALs shall be as required by the Contract. The amount of anti-stripping additive to be added to the mix will be determined by the Engineer based on the Contractor's proposed design and submittal (see the following and Section 9-02.4).

Once the Contractor has determined the aggregate structure and binder content, the Contractor's submittal shall provide data demonstrating that the proposed HMA design meets the requirements of Sections 9-03.8(2) and 9-03.8(6). In no case shall the HMA paving begin before the determination of anti-stripping agent requirement by the Engineer has been made.

5-04.3(6)B2 APPLICATION DEFINITIONS

Unless the Contract specifies otherwise, the following definitions shall be used regarding HMA CI mix designs and apply to all HMA submittals:

<u>Structural application – major quantity:</u>	an HMA CI mix used for vehicular traffic where the project specifies not less than 400 tons of HMA. See Section 504.3(6)C for submittal requirements.
<u>Structural application - minor quantity:</u>	an HMA CI mix used for vehicular traffic where the project specifies less than 400 tons of HMA. See Section 5-04.3(6)D for submittal requirements.
<u>Non-structural application:</u>	an HMA CI mix used for sidewalks, ditches, slopes, paths, trails, gores and other non-vehicular traffic application. See Section 5-04.3(6)E for submittal requirements.

For any quantity structural application, vehicular traffic shall include roadways of any kind for vehicular traffic, alleys, driveways, and other surfaces as may be specified in the Contract.

5-04.3(6)C SUBMITTAL – STRUCTURAL APPLICATION – MAJOR QUANTITY**5-04.3(6)C1 GENERAL**

As a convenience to accommodate accelerated submittals for future uses of an Engineer approved HMA CI mix design major quantity structural application, an Engineer approved HMA CI major quantity structural application mix design shall remain “approved” for use on all future projects with a Bid Opening Date within 365 consecutive calendar days from the date of approval of that specific HMA CI mix. The SPU Materials Laboratory will specify the “approval date” on the returned submittal, and will maintain records on such. On future Contracts, the Contractor shall contact the SPU Materials Laboratory (206-386-1236) to find out if and when a specific major quantity structural application mix design has been Engineer approved.

5-04.3(6)C2 MIX DESIGN AND SAMPLE SUBMITTAL REQUIREMENTS

For HMA CI mix designs not pre-approved by the Engineer as specified in Section 5-04.3(6)C1, the Contractor's HMA CI submittal shall require 20 Working Days and requires both the Contractor mix design and samples.

The following Contractor mix design information shall be submitted for each HMA class:

1. Project name and Public Works (PW) number.
2. HMA class designation and HMA Supplier.
3. Contractor's mix design number, or other designating identification (designation).
4. Design equivalent single axle loads (design ESALs).
5. Aggregate source (also see Sections 1-06.1 and 1-08.3(2) item 6).
6. Aggregate gradations, including blending ratio.
7. Percent (by weight of final mix) of RAP used.
8. Target gradation of final HMA mix.
9. 0.45 power plot of target gradation showing aggregate gradation control points zone.
10. Binder source and performance grade (e.g. – PG xx-yy).
11. Temperature – Viscosity curve of the binder.
12. Recommended binder compaction temperature range.
13. Recommended binder mixing temperature range.
14. Maximum allowable binder temperature.
15. Type and brand of anti-stripping additive.
16. Binder content of RAP (percent by weight of RAP).
17. Percent (by weight of final mix) of binder in final mix (P_b).
18. Effective Binder Content (P_{be}).
19. HMA compaction temperature for the gyratory compactor.
20. Relative density of the final mix at N_{design} gyrations.
21. Number of design (N_{design}) gyrations used (N_{ini} ; N_{des} ; N_{max}).
22. Voids in Mineral Aggregate (VMA).
23. Voids filled with asphalt (VFA).
24. Air voids in the compacted mixture (V_a).
25. Dust/Asphalt Ratio.
26. Sand Equivalent of the aggregate fraction passing U.S. No. 4 sieve.
27. Percent of flat and elongated particles retained on the U.S. No. 4 sieve.
28. Theoretical maximum density of the mix (G_{mm}).
29. Percent of G_{mm} for extruded specimens at N_{ini} , N_{des} and N_{max} .
30. Bulk specific gravity of the extruded specimen at N_{design} gyrations (G_{mb}).
31. Bulk specific gravity of the combined aggregates in the mix (G_{sb}).
32. Effective specific gravity of the combined aggregates in the mix (G_{se}).
34. Bulk specific gravity of the aggregate fraction passing the 3/8" sieve.

35. Bulk specific gravity of the aggregate fraction retained on the 3/8" sieve.

36. Specific gravity of the binder (G_b).

Samples: The mix design submittal shall be accompanied with the following minimum sized samples:

- | | | |
|----|---|------------|
| 1) | The HMA class mix (if RAP is proposed, the mix shall contain the RAP) | 75 pounds, |
| 2) | Asphalt binder(s) | 1 quart |
| 3) | Recycled asphalt pavement component (RAP), if used | 25 pounds |
| 4) | Anti-stripping agent | 1 quart |

Any adjustment to an Engineer approved HMA class JMF will require a submittal (Section 1-05.3(5)) and the approval of the Engineer per Section 9-03.8(7).

Submittal of items "2." through "4." (not "2)" through "4)") above may be waived by the Engineer if the Contractor submits a valid and current WSDOT mix design of the same class of HMA utilizing the same constituents from the same sources as the proposed mix design including anti-stripping agent.

The Contractor may propose an asphalt binder from a secondary source in the same submittal as the primary binder source, and shall make this known in the submittal (see items 10, 11, 12, 13, 16, 17, 18, and 36).

Based on the submittal proposed by the Contractor, the Engineer will determine the anti-stripping additive requirement, and will make this information known on the returned submittal.

If the Engineer determines the submitted mix design is defective, the Engineer will provide written notice identifying such defect as may apply.

The Contractor shall not commence production of any HMA class until that HMA JMF mix design has been established and approved by the Engineer.

Any change in source of supply for any of the constituents of an approved HMA class JMF will require a new mix design be submitted and approved prior to use as specified in this Section.

If the results of the verification testing by the Engineer of the submitted sample Materials and proposed mix design meet the requirements of Sections 9-02.1(4) and 9-03.8, then the submittal will be considered approved. The approved mix design will be the "initial" job mix formula (JMF) for the specified HMA class of mix and an Engineer approval date will be assigned.

To aid the Contractor in preparing the HMA mix design submittal, the Contract will contain an HMA Mix Design Submittal form located in the Appendix of the Project Manual.

5-04.3(6)C3 ACCELERATED SUBMITTAL

When an Engineer approved HMA CI mix design for major quantity structural application is specified in the Contract and this HMA mix is within the 365 calendar Day window before the Bid Opening Date, the Contractor shall submit to the Engineer at least 5 Working Days in advance, a Manufacturer's Certificate of Compliance stating the following:

1. For each HMA class specified in the Contract, the name and location of each Supplier providing the Engineer approved HMA class mix and component parts.
2. Supplier's HMA CI mix design number, or other designating identification (designation) consistent with the Engineer approved HMA class mix.

5-04.3(6)C4 CERTIFICATION TO ACCOMPANY HMA DELIVERY

For any HMA class major quantity structural application mix, each delivery of HMA CI to the Project Site shall be accompanied with a certification stating the following:

- 1) The HMA mix being delivered is an Engineer approved HMA mix,
- 2) Name and location of HMA CI Supplier,
- 3) Supplier's HMA CI mix identification number,
- 4) Date and time of load out,
- 5) Class of HMA,
- 6) Grade of binder,
- 7) Percent (by weight of binder) of anti-stripping agent, and
- 8) Tonnage of HMA in the hauling vehicle.

5-04.3(6)D STRUCTURAL APPLICATION - MINOR QUANTITY

For HMA CI minor quantity structural application mixes, the Contractor shall submit at least 5 Working Days in advance of first use, a Manufacturer's Certificate of Compliance showing items (1) through (7) below.

At the request of the Engineer, the Contractor shall submit the pre-approved mix design data (previously submitted and approved in Section 5-04.3(6)C2).

The Engineer reserves the right to obtain samples of a previously approved HMA CI mix and/or its individual constituents for verification of the mix design.

In addition, every delivery of the HMA CI mix to the Project Site shall be accompanied with a certificate stating the following:

- (1) Name and location of HMA Supplier,
- (2) Supplier's HMA mix identification designation,
- (3) Date and time of load out,

- (4) Class of HMA,
- (5) Binder grade of PG 64-22,
- (6) Percent (by weight of binder) of anti-stripping agent including brand name and type,
- (7) Minimum design ESALs of 10,000,000, and
- (8) Tonnage in vehicle.

5-04.3(6)E NON-STRUCTURAL APPLICATIONS

For HMA CI non-structural application mixes, the Contractor shall submit at least 5 Working Days in advance of first use, a Manufacturer's Certificate of Compliance showing items (1) through (3) below.

At the request of the Engineer, the Contractor shall submit the pre-approved mix design data specified in Section 5-04.3(6)C3.

The Engineer reserves the right to obtain samples of a previously approved HMA CI mix and/or its individual constituents for verification of the mix design.

In addition, every delivery of the HMA CI mix to the Project Site shall be accompanied with a certificate stating the following:

- (1) HMA Class ½ Inch,
- (2) Binder grade of PG 64-22 (binder grade may be substituted as described in Section 5-04.2(1)),
- (3) Supplier designed at any ESAL level, and
- (4) Tonnage in hauling vehicle.

5-04.3(7) HMA MIXING PROCESS

5-04.3(7)A GENERAL

After the required amounts of Mineral Aggregate and asphalt binder have been introduced into the mixer, the HMA shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the asphalt binder throughout the Mineral Aggregates is ensured.

When discharged, the temperature of the HMA shall not exceed the maximum temperature recommended by the asphalt binder manufacturer.

A maximum water content of 1 percent in the HMA, at discharge, will be allowed providing the water causes no problems with compaction, handling, stripping, or flushing. If the water content in the HMA causes any of these problems, the HMA will be considered defective Material. The Contractor shall stop production of the HMA and discontinue the placing of HMA. As specified in Section 1-05.7, the Contractor shall provide a remedy acceptable to the Engineer addressing the water content of the HMA. Defective Material in place shall be removed and replaced with Material that meets the specified requirements.

Storing or holding of the HMA in approved storage facilities will be permitted during the daily operation but in no event shall the HMA be held for more than 24 hours. HMA held for more than 24 hours after mixing will be rejected. Rejected HMA shall be disposed of by the Contractor at no expense to the Owner. The storage facility shall have an accessible device located at the top of the cone or about the third point from the top. The device shall indicate the amount of material in storage. No HMA shall be accepted from the storage facility when the HMA in storage is below the top of the cone of the storage facility, except as the storage facility is being emptied at the end of the working shift.

Where HMA has been held in approved storage and no load out has occurred for 4 continuous hours, then the first 4 tons to be loaded out of the storage facility shall be wasted and disposed of at the Contractor's expense.

5-04.3(7)B ACCEPTANCE SAMPLING AND TESTING – HMA MIXTURE

Acceptance of HMA will be based on the following:

1. **Aggregates.** The acceptance criteria for aggregate properties of sand equivalent, flat and elongated, fine aggregate angularity and fracture will be their conformance to the requirements of Section 9-03.8(2).
2. **Hot Mix Asphalt Mixture.** The acceptance criteria for the HMA mixture shall be as specified in Section 9-03.8(7), HMA Tolerances and Adjustments.

A. Sampling

1. No samples will be obtained from either the first or last 25 tons of HMA produced in each production shift.
2. Samples for acceptance testing will be obtained on a random basis at the point of delivery in accordance with AASHTO T168.

B. Definition of Sampling Lot and Sublot

A lot is defined as a discrete quantity of as-constructed pavement to which an acceptance procedure is applied. For the purpose of acceptance sampling and testing, a lot is defined as the total quantity of Material or work produced for each job mix formula (JMF) placed. A lot is represented by randomly selected samples that will be tested for acceptance. Only one lot per JMF is expected. The initial JMF is defined in Section 5-04.3(7)A, Mix Design. The Contractor may request a change in the JMF in accordance with Section 9-03.8(7). If the request is approved, all of the Material produced up to the time of the change will be evaluated on the basis of tests on samples taken from that JMF and a new lot will begin.

Sampling evaluation will be performed on a random basis at the frequency of one sample per subplot. Sublot size will be determined to the nearest 100 tons to provide not less than two uniform sized sublots, based on proposal quantities, with a maximum subplot size of 400 tons. Sampling and testing will be performed on a random basis as determined by the Engineer. The quantity of material represented by the final subplot may be increased to a maximum of 2 times the subplot quantity calculated.

C. Test Results

The Engineer will furnish the Contractor with a copy of the results of the acceptance testing performed in the Laboratory.

Sublot sample test results may be challenged by the Contractor.

To challenge the Laboratory's test results, the Contractor shall comply with the requirements of Section 1-04.5.

Resolution of this challenge shall be by a split of the original acceptance sample that will be retested by the Owner's Laboratory. The split of the sample with challenged results will not be tested by the same tester that conducted the original acceptance test. The challenge sample will be tested for a complete gradation analysis, for asphalt binder content, and for percent air voids (V_a). The results of the challenge sample will be compared to the original results of the acceptance sample test and evaluated according to the following criteria:

<u>Property</u>	<u>Deviation from JMF</u> <u>Allowable deviation (%)</u>	<u>Standard Specification Reference</u>
U.S. No. 4 and larger sieves	± 4.0 % for each sieve	9-03.8(6)
U.S. No. 8 sieve	± 2.0 %	9-03.8(6)
U.S. No. 200 sieve	± 0.4 %	9-03.8(6)
Asphalt binder content	± 0.3 %	5-04.3(6)C1, item 18
Air Voids in the Compacted Mixture (V_a)	± 0.7 %	5-04.3(6)C1, item 24

If the results of the challenge sample testing are outside the allowable deviation established above for any of the above parameters, the Contractor agrees the subplot is defective and that the subplot shall be removed and replaced and the cost of retesting be deducted at the rates published in Section 1-05.7 from any monies due or that may come due the Contractor under the Contract. If the results of the challenge sample testing are within all parameters established above, the subplot will be accepted and the cost of retesting will be the Owner's responsibility.

D. Test Methods

Testing of HMA for compliance of volumetric properties (VMA, VFA V_a and Dust/Asphalt Ratio) will be by WSDOT SOP 731, "Method for Determining Volumetric Properties of Asphalt Concrete Pavement Class Superpave". WSDOT FOP for AASHTO T 166, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens." WSDOT FOP for AASHTO T 209 "FOP for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures "Rice Density." Testing for compliance of asphalt binder content will be by WSDOT FOP for AASHTO T 308, "Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method." WAQTC FOP TM 6, "Moisture Content of Bituminous Mixtures by Oven." Testing for compliance of gradation will be by WAQTC FOP for AASHTO T 27/T 11.

E. Reject Mixture

- Rejection by Contractor:** The Contractor may, prior to sampling, elect to remove any defective Material and replace it with new Material. Any such new Material may be sampled, tested, and evaluated for acceptance.
- Rejection by Engineer:** Sublots found to be defective during acceptance sampling and testing shall be removed and replaced. In addition, the Engineer may also isolate and reject within a subplot any Material that is determined to be defective.

If, during paving, the Engineer determines Material being placed does not meet Specification, the Contractor shall shut down operations and shall not resume HMA placement until such time as the Engineer is satisfied that specified Material is being supplied.

The Engineer may, without sampling, reject any batch, load, or section of HMA that appears defective in gradation, temperature or asphalt binder content. Material rejected before placement shall not be incorporated into the pavement. Any rejected HMA section of roadway shall be removed. The Contractor may request that he rejected Material be tested. If the Contractor elects to have the rejected Material tested, a minimum of three representative samples will be obtained and tested. Acceptance of rejected Material will be based on conformance with the Specifications. No payment will be made for Material that fails to meet Specification. In addition, the cost of sampling and testing shall be borne by the Contractor. If the Material meets Specification, the cost of sampling and testing will be borne by the Owner and payment for the HMA will be made at the Bid item price.

5-04.3(8) SPREADING AND FINISHING

The mixture shall be laid upon an approved surface, spread, and struck off to the grade and elevation established. HMA paving equipment complying with Section 5-04.3(3)B shall be used to distribute the mixture.

A material transfer vehicle (MTV) shall be used on any paving operation where the daily placement exceeds 800 tons. Should a specific application arise where an MTV is not suitable, the Contractor shall submit a request for a waiver to the Engineer with explanation. The Engineer's approval is required for not using an MTV when daily placement is expected to exceed 800 tons.

Unless otherwise directed by the Engineer, the nominal compacted depth of any layer of any course shall conform to the following limits:

Material	Maximum
HMA Class 1"	0.35 feet
HMA Class 3/4"	0.30 feet
HMA Class 1/2"	0.25 feet
HMA Class 3/8"	0.10 feet

When more than one course is necessary to meet the final paving grade, the first course shall include any widening of the existing roadway and preleveling of the existing pavement surface. The preleveling course or courses shall be constructed so that the final wearing course has a uniform compacted depth and conforms to the finished grade and cross section elevations specified. Construction of one course upon another shall not proceed until the underlying course has cooled and set.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the paving may be done with other approved equipment or by hand.

When more than one JMF is being utilized to produce HMA, the Material produced for each JMF shall be placed by separate spreading and compacting equipment. The intermingling of HMA produced from more than one JMF is prohibited. Each strip of HMA placed during a working shift shall conform to a single JMF established for the class of HMA specified unless there is a need to make an adjustment in the JMF. No adjustment to the JMF will be allowed without approval of the Engineer.

When laying HMA, the paver shall be operated at a uniform forward speed consistent with the trucking delivery rate and roller train capacity to result in a continuous operation. The auger speed and flight gate opening shall be adjusted to coordinate with the operation.

During mainline paving, the wings on the receiving hopper shall not be folded, and the mix level in the hopper shall be maintained so that the conveyors are not exposed, unless the Engineer approves otherwise.

Manual operation of the screed will be permitted in the construction of irregularly shaped and minor areas. These areas include, but are not limited to, gore areas, road approaches, tapers and left-turn channelizations.

When specified in the Contract, reference lines for vertical control will be required. Lines shall be placed on both outer edges of the traveled way of each roadway. Horizontal control utilizing the reference lines will be permitted. The grade and slope for intermediate lanes shall be controlled automatically from reference lines, or by means of a mat referencing device and a slope control device. When the finish of the grade prepared for paving is superior to the established tolerances and when, in the opinion of the Engineer, further improvement to the line, grade, cross-section, and smoothness can best be achieved without the use of the reference line, a mat referencing device may be substituted for the reference line. Substitution of the mat referencing device will be subject to the continued approval of the Engineer. The reference line may be removed after the completion of placing the first course of HMA when approved by the Engineer. Whenever the Engineer determines that any of these methods are failing to provide the necessary vertical control, the reference lines shall be promptly reinstalled by the Contractor before further placement of HMA.

5-04.3(8)A UTILITY ADJUSTMENTS

Utility castings shall be adjusted to finished grade prior to the construction of the final wearing course as described Section 7-20.

5-04.3(9) COMPACTION**5-04.3(9)A GENERAL**

Immediately after the HMA has been spread and struck off, and after surface irregularities have been adjusted, the mix shall be thoroughly and uniformly compacted. The completed course shall be free from ridges, ruts, humps, depressions, objectionable marks, and irregularities and shall conform to the line, grade, and cross-section shown in the Drawings. If necessary, the JMF may be altered in accordance with Section 9-03.8(7) to achieve desired results.

Compaction shall take place when the mixture is in the proper condition so that no undue displacement, cracking, or shoving occurs. All compaction equipment shall be Capable of producing the required compaction. Areas inaccessible to large compaction equipment shall be compacted by mechanical or hand tampers. Any HMA that becomes loose, broken, contaminated, shows an excess or deficiency of asphalt, or is in any way defective, shall be removed and replaced at no additional cost with fresh material which shall be immediately compacted to conform with the surrounding area.

The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided Specification densities are attained. An exception shall be that pneumatic tired rollers shall be

used between October 1st of any year and April 1st of the following year unless the Engineer directs otherwise. Coverages with a vibratory or steel wheel roller may precede pneumatic tired rolling.

Vibratory rollers shall not be operated in the vibratory mode when the internal temperature of the mix is less than 175°F. Regardless of mix temperature, a vibratory roller shall not be operated in a vibratory mode when checking or cracking of the mat occurs. Vibratory rollers in the vibratory mode are prohibited on bridge decks, brick bases, and cobblestone bases.

HMA for preleveling shall be thoroughly compacted to the satisfaction of the Engineer.

5-04.3(9)B CONTROL

5-04.3(9)B1 COMPACTION REQUIREMENT

For an HMA CI having a specified compacted course thickness greater than 0.10 foot, the acceptable level of relative density shall be a minimum 92.0 percent of the reference maximum density. The reference maximum density will be determined by the Engineer as the moving average of the most recent three determinations for the JMF being placed to accommodate start-up for a large placement. Where less than three determinations have been made, the reference maximum density will be the average of all determinations made to that time to accommodate start-up for a large placement. The actual density attained for a subplot of an HMA CI will be determined as the average of five nuclear density gauge tests (after completion of the finish rolling) at randomly selected locations within each density subplot. In addition to the randomly selected locations, the Engineer may select any additional location(s) for testing that appears to be deficient or in any way defective. Such additional tests shall be included in the calculation of the average density for that subplot. The quantity represented by each subplot for density testing will be no greater than a single day's production or 400 tons, whichever is less. For density testing of very large daily placements of HMA, the Engineer may increase the size of the final subplot to a maximum of 600 tons. A lot shall be as defined 5-04.3(7)B.

5-04.3(9)B2 TEST RESULTS

Density sublots not meeting the prescribed minimum relative density shall be considered defective work, and shall be removed and replaced. No payment will be made for defective Material that fails to meet the minimum relative density.

For compaction lots subject to rejection, cores may be used as an alternate to the nuclear density gauge tests. When cores are taken by the Engineer at the request of the Contractor, they shall be requested by no later than 12:00 AM of the next Working Day after receiving the test results. The cores will be taken at locations selected by the Engineer. Cores shall not be located in wheel paths. On sublots which fail to attain the minimum relative density, the cost for the coring will be deducted from any monies due or that may become due the Contractor under the Contract at the rates published in Section 1-05.7.

In addition to the randomly selected locations for relative density tests for a subplot, the Engineer may also isolate any area that is suspected of being defective in relative density. The isolated area will be evaluated as a separate subsubplot. Such isolated area determinations shall be at the sole discretion of the Engineer.

5-04.3(10) JOINTS

5-04.3(10)A LONGITUDINAL AND TRANSVERSE JOINTS

The placing of the top or wearing course shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued for such length of time as to permit the mixture to become chilled. When this work is resumed, the previously compacted mixture shall be sawcut back to produce a slightly beveled edge for the full thickness of the course.

Where a transverse joint is being made and pavement will be open to traffic, a temporary wedge of HMA shall be constructed of a 5:1 H:V slope. The HMA in the temporary wedge shall be separated from the permanent HMA by strips of heavy wrapping paper. When paving operations are renewed, the wrapping paper shall be removed and the joint trimmed to a slightly beveled edge for the full thickness of the new HMA course. The Material which is cut away shall be disposed of and new mix shall be laid against the fresh cut. Rollers or tamping irons shall be used to seal the joint.

All joints shall be flush and provide a smooth transition across the meet line.

The longitudinal joint in any one layer shall be offset from the layer immediately below by not more than 6 inches nor less than 2 inches. All longitudinal joints constructed in the top layer shall be at a lane line or edge line of the traveled way. Where traffic conditions, project geometry or other condition exist that make the construction of longitudinal joints at the lane line or edge of the traveled way impractical or impossible, a longitudinal joint may be constructed at the center of the traffic lane with the Engineer's written approval.

Hot lap joints may be allowed by the Engineer provided planned grades are maintained, no surface irregularities exist and compaction requirements are met. Two paving machines shall be used to construct longitudinal hot lap joints; a minimum average compacted density in accordance with 5-04.3(10) shall be achieved throughout the traffic lane; and construction equipment other than rollers shall not operate on any uncompacted mix.

Immediately following the compaction of the top wearing course, meet line joints where the new asphalt concrete abuts existing asphalt concrete pavements, Portland cement concrete pavements, oil mats, concrete curbs and gutter, etc., shall be sealed per Section 5-04.3(10)B.

5-04.3(10)B NEW PAVEMENT CONNECTIONS WITH EXISTING PAVEMENTS

Where construction of new asphalt concrete pavement connects with an existing roadway surface, driveway, bridge, railway crossing, gutter, or other similar facility, the Contractor shall provide a smooth riding transition between the new surface and existing surface. Such work may require the modification of the existing roadway profile by burning, planing or milling in order to achieve the desired smooth riding transition or may require other adjustment of the new connecting surface.

Butt joints are required at the meet lines of new construction and existing surfaces, the existing abutting pavement shall be trimmed by chipping, planing, milling or such other acceptable method in order to insure a minimum depth of 2 inches of compacted asphalt concrete at the point of connection. Meet lines shall be trimmed straight and the edges vertical. Waste Material resulting from such trimming or chipping shall be disposed of by the Contractor.

Where the transition is to be made by shimming or feathering, it shall be accomplished at the time the final course is being constructed by raking out the oversize aggregate from the HMA class being used. The Contractor shall not leave the asphalt open graded when feathering and shimming down to an existing surface. If approved by the Engineer, shimming and feathering may be accomplished at a later date. In such case, structural HMA Class 3/8 Inch shall be used.

Surfaces to be in contact with the new asphalt shall be tacked in accordance with Section 5-04.3(4)C2.

Meet lines between new and existing surfaces shall be sealed while the new asphalt concrete is still warm by painting with tack coat and then immediately covering the asphalt paint strip with clean, dry paving sand (mineral Aggregate Type 6) complying with Section 9-03.16.

5-04.3(11) RESERVED

5-04.3(12) SURFACE SMOOTHNESS

5-04.3(12)A GENERAL

The completed surface of all courses shall be of uniform texture, be smooth, have a continuous "plane" grade except across the crown. All surfaces shall be free from defects of all kinds. The completed surface of the wearing course shall not vary more than 1/8-inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline. The transverse slope of the completed surface of the wearing course shall vary not more than 1/4-inch in 10 feet from the rate of transverse slope shown on the Drawings.

When deviations in excess of, but not more than twice, the above tolerances are found, the pavement surface shall be corrected to low places, or the removal of Material from high places by grinding with an acceptable grinding machine. The corrected deviation shall be sealed in accordance with Section 5-04.3(18). Where the Engineer determines grinding or filling does not allow for an acceptable repair, removal and replacement of the wearing course of asphalt concrete will be required. Correction of defects shall be carried out until there are no deviations greater than the allowable tolerances.

All areas in which the surface of the completed pavement deviates more than twice the allowable tolerances described above, these areas shall be removed and replaced to the extents determined by the Engineer.

However, if deviations are found which exceed the allowable tolerances but are not in excess of twice the allowable tolerances described above, and, in the opinion of the Engineer, correction by means of any of the methods specified above do not produce acceptable results as to smoothness and serviceability, the Engineer may accept the completed pavement. Under these described circumstances, the decision whether to accept the completed pavement or to require corrections as described above shall be vested entirely in the Engineer.

5-04.3(12)B CONCRETE OVERLAYING ASPHALT

When Portland cement concrete pavement is placed on asphalt concrete pavement, the surface tolerance of the asphalt concrete pavement shall be such that no elevation lies above the proposed finished grade minus the specified depth of Portland cement concrete pavement. Prior to placing the Portland cement concrete pavement, any such irregularities shall be brought to the required tolerance by grinding or other means acceptable to the Engineer.

5-04.3(13) RESERVED

5-04.3(14) RESERVED

5-04.3(15) WEATHER LIMITATIONS

Asphalt for prime coat shall not be applied when the ground temperature is lower than 50°F without written approval of the Engineer.

HMA shall not be placed on any wet surface, or when the average surface temperatures are less than those specified in the following table, or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixtures:

Surface Temperature Limitation		
Compacted Thickness (Feet)	Wearing Course	Other Courses
Less than 0.10	55°F	45°F
0.10 to 0.20	45°F	35°F
0.21 to 0.35	35°F	35°F

5-04.3(16) RESERVED

5-04.3(17) PAVING AND PLANING UNDER TRAFFIC

5-04.3(17)A GENERAL

In addition the requirements of Section 1-07.23 and the traffic controls required in Section 1-10, unless the Contract specifies otherwise or the Engineer agrees to otherwise, the Contractor shall comply with the following:

1. **Intersections:** The Contractor shall keep intersections open to traffic at all times, **except when paving or planing operations through an intersection requires closure. Such closure shall be kept to the**

minimum time required to place and compact the HMA mixture, or plane as appropriate. For paving, such closure shall be scheduled to individual lanes or portions thereof that allow the traffic volumes and schedule of traffic volumes as required in the approved Traffic Control Plan. Work shall be scheduled so that adjacent intersections shall not be impacted at the same time. and shall comply with the traffic control restrictions required by the Traffic Engineer. Each individual intersection closure or partial closure, shall be addressed in the Traffic Control Plan to be submitted to and approved by the Engineer (see Section 1-10.2(5)).

When planing or paving and related construction must occur in an intersection, the Contractor shall consider scheduling and sequencing such work into quarters of the intersection, or half or more of an intersection with side street detours. The Contractor shall also be prepared to sequence the work to individual lanes or portions thereof.

Should closure of the intersection in its entirety be necessary, and no trolley service is impacted, such closure shall be kept to the minimum time required to place and compact the HMA mixture, plane, remove asphalt, tack coat, and as needed.

Any work in an intersection shall include advance warning in both signage and in Working Days advance notice as determined by the Engineer, to alert traffic and emergency services of the intersection closure or partial closure.

Work shall be scheduled so that consecutive intersections shall not have construction in-progress at the same time. New compacted HMA asphalt shall cool to ambient temperature before any traffic is allowed on it. Traffic shall not be allowed on newly placed asphalt until approval has been obtained from the Engineer.

2. **Centerline marking, post-paving temporary marking, temporary stop bars, and maintaining temporary pavement marking:** The Contractor shall comply with the requirements of Section 1-10.3(4)C.
3. **Permanent pavement marking:** The Contractor shall comply with the requirements of Section 8-22.3(1).

5-04.3(17)B SUBMITTALS - PLANING PLAN AND HMA PAVING PLAN

The Contractor shall submit a separate planing plan and a separate paving plan to the Engineer at least 5 Working Days in advance of each operation's activity begin date. These plans shall show, as to be discussed at the pre-planing briefing and pre-paving briefing, how the moving operation and traffic control are coordinated. When requested by the Engineer, the Contractor shall provide each operation's Traffic Control Plan on 24" x 36" or larger size Shop Drawings with a scale showing both the area of operation and sufficient detail of traffic beyond the area of operation where detour traffic may be required. The scale on the Shop Drawing shall be 1 inch = 20 feet, or may be changed if the Engineer agrees sufficient detail is shown.

The planing operation and the paving operation includes, but is not limited to, metal detection, removal of asphalt and temporary asphalt of any kind, tack coat and drying, staging of supply trucks, paving train(s), rolling, scheduling, and as may be discussed at the briefing.

When intersections are to be partially or totally blocked, the Contractor shall provide a minimum 2 Working Days in advance, adequately sized and noticeable signage alerting traffic of closures to come. The Traffic Control Plan shall show where Peace Officers are to be stationed when signalization is to be, or may be, countermanded, and show areas where flaggers are proposed.

At a minimum, the planing and the paving plan shall include the following elements:

1. A copy of the approved traffic control plans (per Section 1-10.2(5)) detailing each day's traffic control as it relates to the specific requirements of that day's planing, and paving. Briefly describe the sequencing of traffic control consistent with the proposed planing and paving sequence, and scheduling of placement of temporary pavement markings and channelizing devices after each day's planing, and paving.
2. A copy of each intersection's traffic control plan (see item 2 in Section 5-04.3(17)A).
3. Haul routes from Supplier facilities, and locations of temporary parking and staging areas, including return routes. The complete round trip shall be described as it relates to the sequencing of paving operations.
4. Names of, and locations of HMA Supplier facility(ies) to be used.
5. Listing of all equipment to be used for paving.
6. Listing of personnel and associated job classification assigned to each piece of paving equipment.
7. Description (geometric or narrative) of the scheduled sequence of planing and of paving, and intended area of planing and of paving for each day's work. Such description shall include the directions of proposed planing and of proposed paving, sequence of adjacent lane paving, sequence of skipped lane paving, intersection planing and paving scheduling and sequencing, and proposed notifications and coordinations to be timely made.
8. Names, job titles, and contact information for field, office, and plant supervisory personnel.

5-04.3(17)C PRE-PAVING AND PRE-PLANING BRIEFING

At least two (2) Working Days **before** the first paving operation and the first planing operation, and as may be scheduled by the Engineer for future paving and planing operations, to ensure the Contractor has adequately prepared for notifying and coordinating as required in the Contract, the Contractor shall be prepared to discuss that day's operations as they relate to other entities and the public's safety and convenience, including driveway and business access, garbage truck operations, Metro transit operations and working around energized overhead wires, school and nursing home and hospital and

other accesses, other contractors who may be operating in the area, pedestrian and bicycle traffic, emergency services, and as may be applicable. The Contractor, and Subcontractors as may be part of that day's operations, shall meet with the Engineer and discuss the proposed operation as it relates to the submitted planing plan and paving plan, approved Traffic Control Plan, public convenience and safety, and as may be necessary. Such discussion shall include, but not be limited to:

1. **General for both Paving Plan and for Planing Plan:**
 - A. The actual times of beginning and ending daily operations;
 - B. In intersections, how break up the intersection, and address traffic control and signalization for that operation including use of peace officers;
 - C. The sequencing and scheduling of paving operations and of planing operations, as applicable, as it relates to traffic control, to public convenience and safety, and to other contractors who may operate in the Project Site;
 - D. Notifications required of Contractor activities, and coordinating with other entities and the public as may be necessary;
 - E. Describe the sequencing of installation and types of temporary pavement markings as it relates to planing and to paving;
 - F. Describe the sequencing of installation of, and the removal of, temporary pavement patch material around exposed castings and as may be needed;
 - G. Describe the procedures and equipment to identify hidden metal in the pavement (such as survey monumentation, monitoring wells, street car rail, and castings) prior to planing (see Section 5-04.3(4)B3a);
 - H. Describe how flaggers will be coordinated with the planing, paving, and related operations;
 - I. Describe the sequencing of traffic controls for the process of rigid pavement base repairs; and
 - J. Other items the Engineer may deem necessary to address.
2. **Paving - additional topics:**
 - a) When begin applying tack and coordinating with paving;
 - b) The types of equipment and numbers of each type equipment to be used. If more pieces of equipment than personnel are proposed, describe the sequencing of the personnel operating the types equipment. Discuss the continuance of operator personnel for each type equipment as it relates to obtaining Specification requirements;
 - c) The number of JMFs to be placed and if more than one JMF, how the Contractor ensures that the different JMFs are distinguished, how pavers and MTVs are distinguished if more than one JMF is being placed at the time, and how pavers and MTVs are cleaned so that one JMF does not adversely influence the other JMF;
 - d) Describe contingency plans for that day's operations such as equipment breakdown, rain out, and Supplier shutdown of operations;
 - e) Number of sublots to be placed, sequencing of density testing, and other sampling and testing.

5-04.3(18) SEALING OF PAVEMENT SURFACES

Any wearing course or other pavement course to be used for the driving surface will be evaluated by the Engineer to determine whether a fog seal is required. Determination will be made when the results of nuclear or core density testing show that a seal is needed. The fog seal shall be CSS-1 or CSS-1h emulsified asphalt uniformly applied to the pavement. The finished application shall be free of streaks and bare spots. The emulsified asphalt shall be diluted at a rate of one part water to one part emulsified asphalt. The diluted emulsified asphalt shall be applied at the rate of 0.10 to 0.18 (0.03 to 0.05 residual) gallons per square yard. The emulsified asphalt shall be applied within the temperature range specified for these asphalt emulsions in Section 5-02.3(3). Unless otherwise approved by the Engineer, the fog seal shall be applied prior to opening to traffic.

5-04.3(19) ANTI-STRIPPING ADDITIVE

Anti-stripping additive shall be added to the HMA in accordance with the Engineer determined anti-stripping additive requirement as made known on the returned submittal (see Section 5-04.3(6)C)2.

5-04.3(20) SHOULDER PAVING

Shoulders, if required, shall be constructed to the lines, grades, and cross-sections specified. Material for building up shoulders shall be Mineral Aggregate Type 1.

5-04.3(21) NON-STRUCTURAL HMA APPLICATIONS

5-04.3(21)A HMA SIDEWALKS

Asphalt walkways shall be constructed at the locations and to the width specified on the Drawings. Unless the Contract specifies otherwise, asphalt walkways shall be constructed with a 4 inch section of compacted crushed rock Mineral Aggregate Type 2 and covered with 3 inches of compacted HMA Class ½ Inch.

5-04.3(21)B HMA DRIVEWAYS

Asphalt driveways shall be constructed as shown on the Drawings. Unless the Contract specifies otherwise, the Contractor shall provide 3 inches of compacted HMA of the class specified in the Contract over 4 inches of compacted Mineral Aggregate Type 2.

5-04.3(22) RESERVED**5-04.3(23) TEMPORARY PAVEMENT PATCHING**

Unless the Contract designates an HMA CL asphalt concrete as a temporary patch Material, the temporary asphalt patch Material shall be in accordance with Section 9-02.5.

The Contractor shall furnish, place and maintain a 4 inch minimum compacted thickness of temporary pavement patch Material over open cuts. Such temporary asphalt patching will be required where vehicular or pedestrian traffic must be accommodated and permanent pavement patching cannot be placed immediately. Trench backfill shall be compacted as specified in Section 7-17.3(3). Temporary pavement patch Material shall be compacted and leveled to coincide with adjacent surfaces.

In the event that the temporary surface subsides after the initial placement, additional temporary pavement patch Material shall be placed over the subsided Material as necessary to maintain a surface level with existing pavement. The Contractor shall timely maintain such temporary patching.

Prior to final restoration of the pavement, the Contractor shall remove the temporary pavement patch Material and such underlying material as may exist, clean the exposed face of the existing pavement to remain, and restore the pavement.

5-04.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for HMA of the class specified will be by the ton whether the HMA is used for structural or non-structural applications, and whether a major quantity or a minor quantity. The net weight of HMA being delivered to the Project Site shall be weighed in the transporting equipment on a certified platform scale, and with accuracy, as specified in Section 1-09.2.

Measurement of HMA of the class specified will be based upon the actual quantity incorporated into the Work as determined by the Material load tickets received and accepted by the Engineer on the day the Material was delivered and incorporated into the Work. Deductions will be made for any asphaltic Material included in the measurement that is not incorporated into the Work on the day delivered.

Measurement for "Roadway Preparation" will be made by a single linear foot measurement along the centerline of the main roadway being prepared. All related intersections, side street approaches, and irregular shaped areas thereto will be incidental to this one measurement. Measurement will be to the nearest whole linear foot.

Measurement for "Surface Preparation, Plane Bituminous Pavement" will be by the square yard and will be based on the average depth shown on the Drawings plus any additional depth up to 4 inch maximum to cover removal of high spots, to cover extra thickness existing pavement, and to cover the extra depth required to provide a 4 inch reveal along the curb line as specified in Section 5-04.3(4)B3b. Should the Drawings indicate or the Engineer order an area be planed in excess of 4 inches, that area planed in excess of 4 inch total depth will be measured in additional square yards of surface planed for up to an additional 4 inch depth. In general, any area planed in excess of 4 inches will be measured by the square yard for each incremental depth of 4 inches. The final planed depth beyond the first 4 inch thickness will include multiples of 4 inches with the last planing pass up to 4 inch maximum. (Example – an area of pavement planed to 9.5 inch total depth will be measured as 3 times the square yardage for that area, or 4 inch + 4 inch + 1.5 inch or up to 4 inch.). Measurement shall also include sweeping to detect metal hidden below the surface for each 4 inch or less depth increment of pavement to be planed.

Measurement for "Surface Preparation, Prelevel" will be by the ton of HMA class placed for preleveling surfaces based on the actual quantity incorporated into the Work as determined by the Material load tickets received and accepted by the Engineer on the day the Material was delivered and placed.

Measurement of permanent pavement patching will be by the ton for the HMA class specified.

Measurement of temporary pavement patch will be made by the ton for the initial placement only. Additional temporary pavement patch required to maintain the surface of the temporary patch level with adjacent roadway surfaces will not be measured. An exception for measuring pavement patch for electrical conduit construction as specified in Section 8-33 will be based on actual measured dimensions with the width of restoration no greater than 24 inches.

Measurement of "Material Transfer Vehicle (MTV)" will be made by the ton of HMA transferred through the MTV and placed. Measurement will not be made for "Material Transfer Vehicle (MTV)" for placed HMA not transferred through the MTV.

5-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-04 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Pavement, HMA (Class)", per ton.**

The Bid item price for "Pavement, HMA (Class)" shall include all costs for the work required to furnish, haul, place and compact the HMA mix, including tack coat, fog seal and sealing joints and meet lines, sand for joints and meet lines, cleaning, and such other work as may be necessary and not otherwise set forth as a separate Bid item in the Bid Form.

2. **"Roadway Preparation", per linear foot.**

The Bid item price for "Roadway Preparation" shall include all costs for the work required to prepare the untreated roadway, including scarifying, blading, shaping, and compacting to remove irregularities and secure a uniform surface except prime coat treatment which will be paid in accordance with Section 5-02.

3. **"Surface Preparation, Prelevel", per ton.**

The Bid item price for "Surface Preparation, Prelevel" shall include all costs for the work required to prelevel uneven or broken treated surfaces by placing and compacting asphalt as specified in Section 5-04.3(4)B2.

4. **"Surface Preparation, Plane Bituminous Pavement"**, per square yard.

The Bid item price for "Surface Preparation, Plane Bituminous Pavement" shall include all costs for the work required to prepare the treated surface including sweeping for hidden metal, exposing metal below the pavement surface where indicated on the Drawings before planing, milling and planing and other type pavement removal as may be necessary, removing and disposing of cuttings, extra planing for butt joints, and feathering meet areas in preparation for an asphalt overlay.

5. **"Crack Sealing"**, per linear foot.

The Bid item price for "Crack Sealing" shall include all costs for the work required to clean and fill the cracks and joints.

6. **"Pavement Patch, Temporary"**, per ton.

The Bid item price for "Pavement Patch, Temporary" shall include all costs for the work required to install and remove the temporary patch. The costs for additional Material required to maintain temporary pavement patches after the initial installation shall be at the sole expense of the Contractor.

7. **"Material Transfer Vehicle (MTV)"**, per ton.

The Bid item price for "Material Transfer Vehicle (MTV)" shall include all costs for the work required to place HMA through the MTV. All cost for the MTV not included in "Material Transfer Vehicle (MTV)" shall be included in other Bid items and no separate or additional payment will be made therefore.

8. **Other payment information.**

Payment for Mineral Aggregate (Type) will be made in accordance with Section 4-01.5.

Payment for removal will be made in accordance with Section 2-02.5.

All costs for the rejection and disposal of Materials held for more than 24 hours after mixing, as specified in Section 5-04.3(8), shall be at the Contractor's sole expense and at no additional or separate cost to the Owner.

When cores are taken by the Engineer at the request of the Contractor, the Owner shall be reimbursed for the coring expenses as specified in Section 1-05.7.

Where samples have been taken by the Engineer from the uncompressed asphalt concrete, new Material shall be placed and compacted at no additional expense to the Owner.

Where the Engineer accepts area of pavement that does not meet the smoothness requirement as specified in Section 5-04.3(12)A, the total payment for yardage of that pavement will be reduced by \$500.00 for each and every increment of section of a single traffic lane of 100 feet in length. Where more than 100 feet of such pavement exists, whether in one or more lanes, payment will be reduced as described. Payment for the last incremental section of said pavement will be reduced by \$500.00 if such last incremental section is less than 100 feet.

Where the placement of asphalt for Portland cement concrete overlay requires grinding to provide for the full thickness of concrete pavement overlay, all expense for grinding shall be at the Contractor's sole expense and no separate or additional payment will be made therefore.

Payment for backfill and compaction of the subgrade shall be included in the Bid item price for the particular Bid item(s) of Work necessitating such work.

Payment for subgrade preparation as required by Section 5-04.3(4)C1 will be in accordance with Section 2-06.5.

Payment for Material used for fog seal as specified in Section 5-04.3(18) will be paid as asphalt for tack coat, except no payment will be made for sealing pavement that has been repaired as specified in Section 5-04.3(12).

All costs for anti-stripping additive as specified in Sections 5-04.3(6) and 5-04.3(19) shall be incidental to and included in the applicable Bid item prices and no separate or additional payment will be made.

All costs for temporary pavement marking and removal shall be incidental to and included in the applicable Bid item prices and no separate or additional payment will be made therefore.

All costs to repair pavement damaged by the removal of temporary marking tape specified in Section 5-04.3(17) shall be at the Contractor's sole expense and no additional or separate payment will be made therefore.

All cost to repair existing pavement to remain, that is damaged by the Contractor's planing as specified in Sections 5-04.3(4)B2 and 5-04.3(4)B3, shall be at the sole expense of the Contractor and no separate or additional payment will be made therefore.

If the Contractor requests and the Engineer approves a change in grade of asphalt binder as specified in Section 5-04.2(1), the Contractor accepts no change in the Bid item price, and no separate or additional payment will be made therefore.

All cost associated with Contractor proposed and Engineer approved use of RAP, and use of substitute asphalt binder grade as specified in Section 5-04.2(1), shall be at no cost to the Owner and no separate or additional payment will be made therefore.

All cost to remove and replace newly placed pavement that is defective shall be at the Contractor's sole expense and no separate or additional payment will be made therefore.

All cost related to planing equipment that is damaged by contacting metal hidden in pavement shall be at the Contractor's sole expense and no separate or additional payment will be made therefore. See Sections 5-04.3(3)D and 5-04.3(4)B3.

All cost for adjusting metal castings below the existing pavement surface shown on the Drawings, and not visible on the surface, shall be in accordance with Section 7-20.5.

All cost related to addressing hidden metal found in pavement as required before beginning planing that are not shown on the Drawings, shall be in accordance with Section 1-04.7.

SECTION 5-05 PORTLAND CEMENT CONCRETE PAVEMENT

5-05.1 DESCRIPTION

Section 5-05 describes work consisting of constructing Portland cement concrete pavements in streets, roads, and alleys on a prepared subgrade or base course in conformity with the lines, grades, thicknesses, and typical cross-sections indicated on Standard Plans and as otherwise indicated in the Contract.

This work shall also consist of constructing Portland cement concrete edge walls, support walls and curb walls at locations shown on the Drawings, and shall further include concrete patching of various types of pavement cuts.

Concrete pavement patching is defined as the restoration of a small or narrow pavement structure cut, less than full panel width, resulting from trench excavation to install underground facilities. Concrete pavement restoration that requires full panel replacement shall be not be treated as "Patching".

5-05.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement and Pozzolans	9-01
Concrete Aggregates	9-03.1
Joint Filler and Joint Sealant	9-04
Mortar for Edge and Support Wall	9-04.3(1)
Reinforcing Bar, Tie and Dowel Bars, and Wire Mesh Reinforcement	9-07
Concrete Curing Materials, Pozzolans, and Admixtures	9-23
Water	9-25.1
Epoxy Resins	9-26
Temporary Pavement Marking	9-29.4

The concrete mix for arterial pavement shall be Class 6.5 (1-1/2), and for residential streets and alleys shall be Class 6 (1-1/2).

Concrete for curb wall and for support wall shall be Class 6 (1-1/2).

Concrete mixes incorporating pozzolans may be utilized for all classes of concrete. Mix proportions will be subject to approval by the Engineer and shall meet the requirements of Section 9-23.9.

Cement concrete pavement patch shall be Class 6.5 (1-1/2) H.E.S.

Water reducing admixtures shall meet the requirements of Section 9-23.6.

The use of calcium chloride will not be allowed.

All concrete mix designs shall be submitted to the Engineer for approval at least 10 Working Days in advance of ordering.

5-05.3 CONSTRUCTION REQUIREMENTS

5-05.3(1) PROPORTIONING MATERIALS

Each batch of concrete delivered to the Project Site shall be accompanied with a Manufacturer's Certificate of Compliance indicating the batch weights.

The class of concrete for non-structural uses refers to the nominal number of sacks of Portland cement per cubic yard concrete mix, although this designation does not constitute a guarantee of yield. The figure in parenthesis indicates the maximum size of aggregate particle. Example: "C1 5 (1-1/2)" is a 5 sack Portland cement concrete mix with 1-1/2 inch maximum size coarse aggregate.

H.E.S. indicates high-early-strength Portland cement and may be included in the class of concrete. Example: "C1 6 (1-1/2) H.E.S." is a 6 sack high early strength Portland cement concrete mix with 1-1/2 inch maximum size coarse aggregate.

With approval of the Engineer, the Contractor may use high-early-strength Portland cement in any of the mixes (see submittal requirement in Section 5-05.2).

Air-entrained concrete shall be used.

The volume of entrained air in freshly mixed concrete shall conform to that specified in the following table:

Air Content of Freshly Mixed Concrete	
Maximum Size of Coarse Aggregate (Inches)	Air Content Percent by Volume
1-1/2, 2 and 3	5 ± 1
3/4 and 1	6 ± 1
3/8 and 1/2	7-1/2 ± 1

If the measured air content is found outside the range of values contained in the table, the Contractor shall immediately make changes in mixing or Materials as necessary to comply with the requirements for air content.

Fine and coarse aggregates shall be proportioned by weight except that if project pavement construction is small, volumetric proportioning may be used with advanced permission of the Engineer. In proportioning, the unit of measure for Portland cement will be by the 94 pound sack.

Weights of fine and coarse aggregate are based on a bulk specific gravity, saturated surface dry, of 2.67.

Concrete mixes shall be proportioned as specified in the table which follows. The weight of each size of aggregate is the estimated quantity to be used with one sack of cement. With approval of the Engineer (see submittal requirements in Section 5-05.2), the proportion of aggregate may be altered to give better workability.

Class of Concrete (Maximum Aggregate Size)	5 (3/4)	5 (1-1/2)	5.5 (1-1/2)	6 (3/4)	6 (1-1/2)	6.5 (1-1/2)	Section Reference
28 day Compressive Strength, lbs. per sq. in.	2,300	2,300	2,500	3,000	3,000	3,600	....
Sacks per Cubic Yard	5	5	5.5	6	6	6.5	....
Pounds dry Fine Aggregate No. 1	....	275	248	....	220	210	9-03.1(2)
Pounds dry Fine Aggregate No. 2	291	....	....	203	....	....	9-03.1(2)
Pounds No. 2 Coarse Aggregate	....	....	....	....	....	280	9-03.1(3)
Pounds No. 4 Coarse Aggregate	....	166	150	....	132	....	9-03.1(3)
Pounds No. 5 Coarse Aggregate	387	248	223	320	201	....	9-03.1(3)

In adjusting concrete mixes, the following water-cement ratios shall not be exceeded:

Cement Sacks (Sacks Per Cubic Yard)	Maximum Water (Gallons Per Sack)
4	8.2
5	6.5
5.5	6.0
6	5.5
6.5	5.1

"Sack" = 94 pound bag Portland cement.

5-05.3(2) CONSISTENCY (SLUMP REQUIREMENTS)

The Materials shall be mixed with sufficient water to produce a stiff concrete which holds its shape when deposited upon the base course or subgrade. Concrete placed during wet weather shall be mixed with sufficient water to produce a very stiff mixture. The consistency shall be such that separation of the mortar from the coarse aggregate shall not occur in handling.

Slump shall be measured in accordance with ASTM C 143 "Method of Test for Slump of Portland Cement Concrete".

The water/cement ratio shall not produce a mix with a slump greater than 2 inches for other than slip form construction, and 1/2 inch for slip form construction. Concrete slump with water-reducing agent shall not exceed 3-1/2 inches. A water-reducing agent shall be added to the concrete mix when:

1. The Contractor elects to hand-screed and/or hand-finish concrete paving work in lieu of using a mechanical finishing machine, or
2. Increased workability is necessary due to weather conditions or other variables, and is acceptable to the Engineer.

5-05.3(3) EQUIPMENT

Equipment necessary for handling Materials and performing all parts of pavement construction shall require approval by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the Project Site sufficiently ahead of the start of paving operations to be examined thoroughly.

1. **Batching plant and Equipment:**
 - a. **General:** The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and

vented to preclude dusting during operation. The batching plant shall be equipped with a suitable nonresettable batch counter which correctly indicates the number of batches proportioned.

- b. **Bins and hoppers:** Bins with adequate separate compartments for fine aggregate and for each size of the coarse aggregate shall be provided in the batching plant.
- c. **Scales:** Plant and truck scales shall meet the requirements of Section 1-09.2.
- d. The batching plant shall be equipped to proportion aggregates and bulk cement by means of automatic weighing devices of an approved type.

2. **Mixers:**

- a. **General:** Concrete may be mixed at a batching plant or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.
- b. **Batching plant:** Mixing shall be in an approved mixer Capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period. The mixer shall be equipped with an approved timing device which automatically locks the discharge lever when the drum has been charged and releases it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released.

Mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down 3/4 inch or more. The Contractor shall have available at the Project Site a copy of the manufacturer's design, showing dimensions and arrangements of the blades in reference to original height and depth, or provide permanent marks on blades to show points of 3/4 inch wear from new conditions. Drilled holes 1/4 inch in diameter near each end and at midpoint of each blade are recommended.

- c. **Truck mixers and truck agitators:** Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling plant-mixed concrete, shall conform to and accommodate the requirements of Sections 6-02.3(3) and 6-02.3(4).
- d. **Nonagitator trucks:** Bodies of nonagitating hauling equipment for concrete shall be smooth, mortar-tight, metal containers and shall be Capable of discharging the concrete at an acceptable controlled rate without segregation. If discharge of concrete is accomplished by tilting the body, the surface of the load shall be retarded by a suitable baffle. Covers shall be provided when needed for protection. Plant-mixed concrete may be transported in nonagitated vehicles provided that the concrete is delivered to the site of pavement construction and discharge is completed within 45 minutes after the introduction of mixing water to the cement and aggregates, and provided the concrete is in a workable condition when placed.

3. **Finishing Equipment:**

- a. The standard method of constructing concrete pavement on roadways shall be with one or more self-propelled paving machines which spread, screed, shape and consolidate the freshly placed concrete between stationary side forms. The Contractor may option to use approved slip-form paving equipment designed to spread, consolidate, screed and float-finish the freshly placed concrete in one complete pass of the machine with minimum of hand finishing.
- b. On projects requiring less than 500 square yards of cement concrete pavement or on projects requiring individual placement areas of less than 500 square yards, irregular areas and at locations inaccessible to self-propelled paving equipment, cement concrete payment may be placed with approved placement and hand finishing equipment utilizing stationary side forms. Hand screeding and float finishing of cement concrete pavement may only be utilized on small irregular areas as allowed by the Engineer.
- c. Along with the basic tools required for compacting and finishing concrete pavement, a long handle, 10-foot metal straight edge for checking the surface smoothness as described in Section 5-05.3(12), shall be furnished by the Contractor and shall be at the site of pavement construction prior to the commencing of placing concrete. The straight edge shall be lightweight, straight and true, equipped with a long handle to allow for checking the smoothness of the surface along the entire width of the pavement section.

4. **Joint Sawing Equipment:**

- a. The Contractor shall provide approved power driven saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the pavement construction at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the pavement construction site both before and continuously during concrete placement. Sawing equipment shall be available immediately and continuously upon call by the Contractor on a 24 hour basis, including Saturdays, Sundays and Holidays.

5. **Smoothness Testing Equipment:**

- a. Along with the basic tools required for compacting and finishing concrete pavement, a long-handle, 10-foot straight edge for checking the surface smoothness as described in Section

5-05.3(12) shall be furnished by the Contractor and shall be at the site of pavement construction prior to the commencing of placing concrete. The straight edge shall be lightweight, straight and true, equipped with a long handle to allow for checking the smoothness of the surface along the entire width of the pavement section.

- b. On large paving projects ("large" is defined as 1000 LF or more of continuous concrete pavement) the Contractor shall provide a California type computerized profilograph, complete with recorder, for determining the profile index of the pavement according to WSDOT Test Method No. 807.

The profilograph shall be on the Project Site, calibrated, in good working condition, and ready for operation before construction of any concrete pavement begins.

The operator shall be competent and experienced in operation of the equipment.

5-05.3(4) HANDLING, MEASURING, AND BATCHING MATERIALS

The batch plant site, layout, equipment, and provisions for transporting Material shall ensure a continuous supply of Material to the location of pavement construction. See Section 5-05.3(1) regarding batch ticket reporting requirements.

1. Measuring Materials:

- a. **Aggregates:** The fine aggregate and each size of coarse aggregate shall be measured by weighing, the weight for the particular aggregates used being proportional to their respective bulk specific gravities. The weighing of each size of Material shall be a separate and distinct operation.

Corrections shall be made for variations in weight of Materials due to the moisture content.

The equipment for weighing aggregates shall conform to the requirements of Section 1-09.2.

- b. **Cement:** Cement shall be weighed on scales meeting the requirements of Section 1-09.2. Adequate provision shall be made to prevent loss of cement between the batch box and the mixer.
- c. **Water:** Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over 1 percent.

2. Batching Materials:

- a. On all projects requiring more than 2,500 cubic yards of Portland cement concrete for paving, the batching plant shall be equipped to proportion aggregates and cement by weight by means of automatic and interlocked proportioning devices of approved type.

5-05.3(5) MIXING CONCRETE

5-05.3(5)A GENERAL

The concrete may be mixed in a batching plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all Materials are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of Sections 6-02.3(3) and 6-02.3(4).

When mixed in a batching plant, the mixing time shall not be less than 50 seconds nor more than 90 seconds.

The mixer shall be operated at a drum speed as shown on the manufacturer's name plate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at no expense to the Owner. The volume of concrete mixed per batch shall not exceed the mixer's rated capacity, as shown on the manufacturer's standard rating plate on the mixer.

Each concrete mixing machine shall be equipped with a device for counting automatically the number of batches mixed during the day's operation.

All elements of a batch shall be simultaneously and continuously fed to the mixer to ensure uniform distribution of cement, water, aggregates, and admixtures.

Retempering concrete by adding water or by other means will not be permitted. Admixtures for increasing the workability or for accelerating the set will be permitted only when specified, or when approved by the Engineer.

5-05.3(5)B LIMITATIONS OF MIXING

Concrete shall not be mixed, placed, or finished when the natural light is inadequate, unless an adequate and approved artificial lighting system is operated.

Mixing and placing concrete shall be discontinued when a descending air temperature in the shade away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F unless authorized in writing by the Engineer.

When mixing and placing is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might injure the Materials. The temperature of the mixed concrete shall be not less than 50°F and not more than 90°F at the time of discharge into the hauling conveyance. No concrete shall be mixed with frozen aggregates.

5-05.3(6) SUBGRADE

Subgrade shall be constructed, and maintained, in accordance with the requirements of Section 2-06.

Where thickened edges for pavements are required, such as shown on the Standard Plans, the subgrade shall be excavated and shaped to provide for the section shown.

Wherever possible, traffic and equipment shall be kept off the finished subgrade. If equipment must travel on the subgrade ahead of the paving, a power drag shall be carried immediately ahead of placing concrete. Irregularities in the subgrade caused by any equipment during the placement of concrete shall be smoothed out and compacted immediately ahead of placing the concrete.

5-05.3(7) PLACING, SPREADING, AND COMPACTING CONCRETE

All the requirements for concrete mix, density, finish and surface smoothness apply regardless of the methods used to place concrete pavement.

5-05.3(7)A CONCRETE PAVEMENT CONSTRUCTION - GENERAL

Concrete shall be placed, spread, and consolidated between stationary forms by means of an approved paving machine or an approved slip-form paver at the Contractor's option. Hand methods of spreading and consolidating concrete shall be limited to pavement patching, to small panel replacement, to irregular areas, and to pavement placed in confined areas.

Where pavement structures have grades of 4 percent or more, the direction of the paving operation shall be uphill, starting from the lowest street elevation.

Unless otherwise specified in the Contract, paving widths from 25 feet to 44 feet shall be paved in 2 operations with compensation allowed for thickened edge on each side of the included longitudinal construction joint. Should the Contractor be allowed to pave in more than 2 operations for the above widths, the additional thickened edges required due to installation of more than one construction joint shall be made at no additional expense to the Owner. When "hand" screeding methods are allowed, paving widths shall not exceed 12 feet on arterials or 13 feet on non-arterials. Full-width paving will be allowed only with written permission of the Engineer.

Keyways shall be provided at all longitudinal construction joints and at transverse construction joints without dowels.

Mixers and trucks shall be operated on the subgrade or on the shoulder adjacent to the lane being paved. Newly paved lanes shall not be used for mixers, trucks or other construction equipment unless the concrete pavement meets the requirements set forth in Section 5-05.3(17).

A protective ramp shall be constructed at the pavement structure edge where equipment may be driven on and off the existing pavement. The forms shall be left on the outside edge of the first lane at all turnouts until the pavement is opened to traffic.

Where tie bars are required, they shall be placed before the concrete is poured, except when slip form paving machines equipped with an approved tie bar insertion device are used (see Standard Plan no. 405). If the tie bars impede the flow of traffic, the tie bars shall be protected from traffic by bending down the back against the side form. Prior to placing concrete in the adjacent lane, the tie bars shall be straightened.

An 1/8-inch thick metal plate, 5 inches wide and no less than 10 feet long, shall be placed flat on top of the completed pavement along its edge at the common joint with the adjacent pavement slab to be poured. The concrete shall be struck off from this plate, either by machine or by hand placement methods.

All pavement and other surfaces in use by the Contractor shall be kept adequately moist to prevent the accumulation of dust on the freshly placed concrete.

5-05.3(7)B SLIP FORM CONSTRUCTION

At the option of the Contractor and with the approval of the Engineer, concrete pavement may be constructed by the use of slip-form paving equipment.

Slip-form paving equipment shall be provided with traveling side forms of sufficient dimensions, shape and strength to support the concrete laterally for a sufficient period of time during placement to produce pavement of the required cross section and the equipment shall spread, consolidate, screed, and float-finish the freshly placed concrete in such a manner as to provide a dense and homogenous pavement.

The concrete shall be distributed uniformly into final position by the slip-form paver and the horizontal deviation in alignment of the edges shall not exceed the 1/2 inch from the alignment established by the Engineer.

The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that stands normal to the surface with sharp well defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.

The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of pavement and/or a series of equally spaced longitudinal vibrating units. The space from the outer edge of the pavement to the outer longitudinal unit shall not exceed 9 inches. The spacing of internal units shall be uniform and not exceed 18 inches.

The term internal vibration means vibration by vibrating units located within the specified thickness of pavement section and a minimum distance equal to the pavement thickness ahead of the screed.

The rate of vibration of each vibrating unit shall be not less than 7500 cycles per minute, and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 1 foot. The frequency of vibration or amplitude shall be varied proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency, having a slump as specified in Section 5-05.3(2). The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

Regardless of the method or machinery used to construct pavement, depressed curb for driveways and ramps shall be provided at those locations indicated on the Drawings or as required by the Engineer. When a slip-form paving machine is used for pavement construction, the Contractor shall block out the pavement area beneath areas where depressed curb is to be constructed. Such blocked out pavement areas, together with the depressed curb sections, shall then be constructed concurrently with the cement concrete item needing the depressed curb.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement, shall be equipped with protective pads on crawler tracks or rubber-tired wheels and shall be offset to run a sufficient distance from the edge of the pavement to avoid breaking or cracking the pavement edge.

After the concrete has been given a preliminary finish by the finishing devices in the slip-form paving equipment, the surface of the fresh concrete shall be checked with a straight-edge to comply with the tolerances and finish specified in Section 5-05.3(12).

With slip-form construction, tie bars shall be set in place along the longitudinal joint. Keyway will not be required on sawcut longitudinal joints.

5-05.3(7)C STATIONARY SIDE FORM CONSTRUCTION

Forms and headers and their placement shall meet the requirements of Section 5-05.3(21).

The concrete shall be placed upon the prepared subgrade or base between the forms to the required depth and cross section in a continuous operation between construction or expansion joints. No concrete shall be placed until the forms are approved by the Engineer.

The concrete shall be thoroughly consolidated by mechanical vibration. Complete consolidation is required along all forms or adjoining pavements by such means which prevent gravel pockets along the edges of the finished pavement. Any gravel pockets found after removing the forms shall be repaired by the Contractor.

When integral curb is being constructed with the pavement, fresh concrete for the integral curb shall be placed at such time which enables the top section of the curb to be consolidated, finished, and bonded to the pavement slab while the concrete is plastic.

Where curb is required, and such curb is not being placed integrally with the pavement slab, dowels shall be placed in the pavement slab as specified in Section 8-04.

5-05.3(7)D PLACING CONCRETE AT THROUGH JOINTS

Concrete placement around through joints shall be such that the through joint assembly shall not be disturbed and that it shall remain in a straight line perpendicular to the subgrade, as shown on the Standard Plans. The concrete shall then be vibrated along the entire length of the joint to consolidate the concrete and leave no rock pockets anywhere at the joint.

5-05.3(7)E PLACING CONCRETE WITH REINFORCING STEEL OR WIRE MESH

Concrete shall not be placed until the subgrade and the reinforcing steel or wire mesh has been approved by the Engineer. The Contractor shall use positive reinforcing steel or wire mesh as shown on Drawings and shall ensure the reinforcing steel or mesh is not displaced as the concrete is placed.

Reinforcement shall be free of dirt, mill scale, oil, grease, or other foreign Material that may impair bond. Steel, coated with rust, may be used if the oxidations are not deep or loose coated.

Requirements for placing and fastening reinforcing steel are specified in Section 6-02.3(24)D.

Successive mats of steel or wire mesh shall be securely lapped together and tied so that longitudinal bars lap a minimum 40 diameters and wire mesh laps 6 to 12 inches.

Reinforcement shall be laid as a continuous mat. Continuity shall be maintained between expansion joints. Steel shall terminate at the designated locations in the slab.

5-05.3(7)F COMPACTING CONCRETE

5-05.3(7)F1 GENERAL

All cement concrete pavement shall be vibrated. Vibration shall be by internal vibration, and/or surface vibration.

5-05.3(7)F2 INTERNAL VIBRATION

Internal vibrations shall comply with Section 6-02.3(8) except that slip-form paver vibration shall comply with Section 5-05.3(7)B, and combined vibration and machine compaction shall comply with Section 5-05.3(7)F4.

5-05.3(7)F3 MACHINE COMPACTION

The machine used for compacting shall be self-propelled and designed to run on the side forms. Movable parts shall be Capable of adjustment and they shall be adjusted so as to produce accurately the roadway sections shown on the Drawings. The machine shall be equipped with two reciprocating screeds. The tops of the forms shall be kept clean with a suitable device attached to the machine.

The travel of the machine on the forms shall be maintained true without lift, wobble or other variations which might prevent a precise strike off.

The machine shall be put in forward motion as soon as concrete is deposited on the subgrade. On the first pass, a roll of concrete shall be carried ahead of the screed. Screeds and tampers shall be operated so as not to disturb expansion joints and caps.

Machines shall be operated prior to placing longitudinal and transverse dummy joints.

Machines shall be operated at least twice and as many more times as may be necessary to compact concrete free from rock pockets, and to a section that can be finished properly.

Care shall be exercised not to overwork the concrete and being an excess of mortar to the surface.

5-05.3(7)F4 COMBINED VIBRATION AND MACHINE COMPACTION

The combined vibration and compaction equipment shall be demonstrated as being Capable of consolidating the concrete across the full width of the pavement into a homogenous mass, free of rock pockets, and without separation of mortar and aggregate.

The vibration equipment shall be either as described in Section 5-05.3(7)F3, or shall be an approved spreading machine to which is attached a vibrating unit composed of individual internal vibrators spaced not more than 29 inches apart. The vibrators shall be spaced equidistantly, and the distance from the side forms to the nearest vibrator shall not exceed 14 inches. The vibrators shall be carried behind and independent of the strike-off screed of the spreading machine, or ahead of and independent of the strike-off screed of the first compacting machine.

The vibrating unit shall not rest upon the side forms nor impart vibration to the strike-off screeds. The individual vibrators shall be attached to a frame in a manner which permits adjustment of both the depth of penetration into the concrete and the angle of the vibrator with the horizontal.

The entire vibrating unit shall allow raising the vibrator tips completely clear of the concrete surface.

The vibrator shall be Capable of vibrating at rates between 4,800 and 8,000 pulses per minute when inserted in the concrete. All vibrators shall be synchronized to vibrate at a frequency specified by the Engineer, within the limits established.

On the first trip over the freshly placed concrete the vibration equipment shall be submerged in the concrete to ensure adequate consolidation. The vibration equipment shall be operated on the first pass only. The vibration equipment shall not be operated when the machine is not in motion except when vibrating near an expansion joint.

After the first pass with vibration, additional passes without vibration shall comply with Section 5-05.3(7)F3.

5-05.3(7)F5 VIBRATING SCREED CONCRETE PAVEMENT CONSTRUCTION

The type of vibrating screed which the Contractor proposes to use, whether roller or beam, shall be subject to the approval of the Engineer. Upon request by the Engineer, a test section of pavement shall be placed for the purpose of demonstrating the capabilities of the screed to acceptably compact and strike off the concrete to the established grade and section.

Concrete shall be uniformly distributed between the forms and it shall then be compacted and screeded to the level of the top of the forms by means of the vibrating screed. Supplemental compaction by mechanical vibration of the concrete adjacent to the forms will be required if the concrete cannot be acceptably compacted by the vibrating screed.

The vibrating screed shall be operated over the freshly placed concrete in successive passes only a sufficient number of times to obtain maximum compaction. Over-vibration of the concrete, resulting in an excess of mortar at the surface of the pavement, will not be permitted.

After the final passages of the vibrating screed, the surface of the concrete shall be at the established pavement grade and cross section and shall be sufficiently smooth as to require only a very moderate amount of hand finishing for smoothness to meet approval of the Engineer.

5-05.3(8) JOINTS**5-05.3(8)A GENERAL**

Transverse and longitudinal joints shall be contraction or through joints (including construction joints). Joints shall be constructed in accordance with Standard Plan no. 405 and shall be of the type and at the locations indicated on the Drawings. The faces of all joints shall be constructed perpendicular to the surface of the cement concrete pavement.

5-05.3(8)B CONTRACTION JOINTS**5-05.3(8)B1 FORMED CONTRACTION JOINTS**

Formed contraction joints shall be constructed by embedding a ¼-inch thick premolded joint Material as indicated on Standard Plan no. 405. The depth of the formed joints shall be 1/3 of the pavement thickness. The filler shall be cut to the exact section of the joint. The length of the premolded joint filler shall extend to within 1/4-inch of any panel edge.

Transverse contraction joints (dummy joints) shall be placed after compaction and finishing of concrete have been completed and before initial set. A vertical groove shall be cut into the surface at the location of the joint, using a tool provided with stops (tee iron) to prevent cutting the groove deeper than the planned depth. The preformed joint Material shall then be embedded into the groove until the top is flush with the pavement surface, with a deviation of not more than 1/8-inch below the surface. The joint filler shall be perpendicular to the surface and always in a straight line.

After the joint filler has been embedded in the concrete, the surface of the pavement shall be finished against the filler strip with hand floats to restore the surface finish. While performing this operation, the filler strip shall be maintained in a perpendicular position, true to alignment. After finishing the entire area, the joint shall be true to grade, smooth and without irregularities.

The premolded joint filler may be omitted provided the joints are subsequently sawed in accordance with the provisions of Section 5-05.3(8)B2.

5-05.3(8)B2 SAWED CONTRACTION JOINTS

Sawed contraction joints shall be constructed by sawing a vertical groove in the hardened concrete on an approved schedule after placing and before development of random cracks in the concrete slab. The depth of sawcut shall be 1/3 the pavement thickness and shall not cut underlying pavement tie bars and dowel bars (see Standard Plan no. 405). Transverse contraction joints shall be sawed before the longitudinal joints are sawed. The first set of transverse joints shall be sawed at a maximum of 60 foot intervals, as soon as the cut can be made without undue raveling of concrete. Intermediate joints shall be sawed immediately following the first set of joints. The Contractor shall provide the Engineer a minimum 4 hours advance notice of sawcutting.

Any scheduling for the sawing of joints that results in premature or uncontrolled cracking shall be revised immediately by adjusting the time interval between placing of concrete and the sawing of joints. After the revised schedule has been accepted by the Engineer, the sawing shall proceed as a continuous operation until all joints have been completed.

Two or more sawing units may be required to accomplish the sawing in order to minimize random cracking. Standby equipment shall be on the job to ensure continuity of sawing regardless of any breakdown of equipment.

Where curing membrane is used, the area disturbed by sawing of joints shall be resprayed immediately upon completion of the sawing operation and care shall be exercised to prevent the curing compound from getting into the groove. Joint sealing compound shall not adhere to concrete if curing compound is present.

The concrete saw shall be powered adequately to perform the required cutting. It shall cut a uniform groove to the required depth and not less than 3/16-inch nor more than 5/16-inch in width. The Contractor will be expected to so arrange the schedule of sawing joints, including initial sawing, at the required intervals so that every possible effort is made to control cracking by the use of judiciously spaced and timed sawed joints. In the event random cracks occur, they shall be repaired in accordance with Section 5-05.3(22). The Contractor shall provide at least one standby saw in good working order to insure continuous sawing as specified regardless of any breakdown of equipment. An ample supply of sawblades shall be maintained at the site of pavement construction at all times during sawing operations. The Contractor shall provide artificial lighting facilities for night sawing. All equipment required for sawing shall be at the pavement construction site both before and continuously during concrete placement. Sawing equipment shall be available immediately and continuously on a 24 hour basis, including Saturdays, Sundays and legal Holidays.

Damage to curing Material caused by sawing operations shall be repaired immediately after completion of sawing.

Formed transverse contraction joints shall be installed where designated by the Engineer, if necessary to prevent uncontrolled transverse cracks from occurring before the pavement can be sawed.

5-05.3(8)B3 SEALING SAWED CONTRACTION JOINTS

Sawed contraction joints shall be filled with a joint sealant filler conforming to the requirements of Section 9-04.2. Joints shall be thoroughly cleaned at the time of sealing. If hot-poured type sealant is used, the joints shall be dry. Care shall be taken to avoid air pockets. The hot-poured compound shall be applied in two or more layers, if deemed necessary by the Engineer. The cold-poured compound shall be applied under sufficient pressure to fill the groove from the bottom to a point approximately 1/4-inch below the surface of the concrete. The joint filled with cold-poured compound shall then be covered with a strip of nonabsorptive paper at least twice as wide as the joint. The paper shall be left in place.

If contraction joints are formed with plastic strips, sealing is not required.

Excess sealing Material shall be cleaned off the surface of the pavement before opening to traffic.

5-05.3(8)C THROUGH JOINTS**5-05.3(8)C1 EXPANSION JOINTS**

Expansion joints are placed only where shown on the Drawings. The joint alignment shall be at right angles to the pavement structure centerline unless otherwise specified in the Contract.

Longitudinal expansion joints shall be placed where shown on the Drawings or where required for concrete pavement between or along retaining walls, curbs or other structures.

Expansion joints shall be constructed with premolded Material, 3/4-inch in thickness, and conform to Section 9-04.1(2). They shall extend from 1 inch below the subgrade to 1 inch below the top of the pavement. Transverse expansion joints shall extend the full width of pavement structure.

The joint Material shall be held accurately in place during the placing and finishing of the concrete by a bulkhead, a holder, a metal cap or any other approved method. The joint shall be perpendicular to the paved surface and the holder shall be in place long enough to prevent sagging of the Material, especially on streets having steep grades.

In multiple lane construction, the joints shall be matched so as to form a continuous alignment across all lanes.

Expansion joints shall extend continuously through all curbs, special care being exercised to preserve alignment perpendicular to the pavement in the curb section.

A wood filler strip or metal cap shall be placed on the top of the premolded joint filler to form the groove 1 inch deep, and it shall remain in place until after the finishing and the concrete is sufficiently set to resist sloughing into the groove. The joint filler shall be stapled together at the ends to preserve continuity.

Immediately after removal of side forms, the edges of the pavement shall be carefully inspected and wherever the joint filler is not fully exposed, the concrete shall be chipped down until the edge of the filler is fully exposed for the entire depth.

5-05.3(8)C2 CONSTRUCTION JOINTS

All longitudinal construction joints shall be constructed with keyway and tie bars as detailed on Standard Plan no. 405. Along with keyway and tie bars, a thickened edge shall be required on pavements less than 9 inches in thickness for Type B joints, and less than 10 inches thickness for Type A joints.

Transverse construction joints formed by placing a header board transversely across the subgrade shall be made at the end of each day's paving or when placing of standard mixed concrete is discontinued for more than 60 minutes or when placing of high early strength concrete is discontinued for more than 30 minutes. The header board shall be located to conform to the spacing for the transverse contraction joints (or an expansion joint) and shall be left in place until the paving is resumed. If the location of the header board is to be a contraction joint, then the header shall have fastened to the concrete side a wedge-shaped strip of wood or preformed plastic to form a key in the concrete. Thickened edge shall be constructed at the construction joint header to provide ample depth of concrete above and below the keyway. For dowel bar requirements, see Section 5-05.3(10).

Where preformed contraction joints are used, the joint made by the construction joint header shall have a 2-inch strip of joint Material imbedded against the hardened concrete when paving is resumed.

5-05.3(8)C3 SEALING THROUGH JOINTS

After the pavement is cured, and before carrying any traffic, the space left by the removal of the wood filler strip or the metal cap above the top of the expansion joint filler strip shall be thoroughly cleaned of all loose material. The 3/4-inch wide groove shall be completely free of any projecting concrete from the sides and the groove shall be continuous across the slab to each edge. It shall then be filled level with the pavement surface with joint sealant meeting the requirements of Sections 9-04.2(2).

The joint sealant Material shall be heated and placed in accordance with the manufacturer's instructions. Burned Material will be rejected. The through joint groove shall be dry at the time of pouring the sealing compound.

5-05.3(8)D JOINT LOCATION

5-05.3(8)D1 TRANSVERSE JOINTS

Standard spacing of transverse contraction joints along straight sections of pavement structures (between through expansion joints or between intersections or other irregular areas), shall be at intervals no greater than 15 feet across the full width of the pavement structure and at right angles to the center line of Traveled Way. Where the spacing between transverse through expansion joints or between intersections or other irregular areas are not in even multiples of 15 feet, the last several spaces approaching the expansion joint or header shall be varied by shortening the spaces. The Contractor shall give advance notice to the Engineer and coordinate the spacing. On horizontal curves, the joint spacing of 15 feet shall be measured along the outer edge of the outside lane and at right angles to the center line.

When paving adjacent to existing pavement or a previously paved lane, the new transverse joints shall be placed to match joint locations in the adjacent pavement. Where the existing joint spacing is greater than 15 feet, intermediate transverse joints shall be constructed. The Contractor shall give advance notice to the Engineer and coordinate the spacing.

For intersections and other irregular areas, the arrangement of contraction joints shall be in accordance with standard intersection patterns. The area of any one irregular panel formed by contraction joints in intersections shall not exceed 225 square feet and its greatest dimensions shall not exceed 15 feet. The Contractor shall give advance notice to the Engineer and coordinate the spacing.

Where uncontrolled cracks have appeared or exist in the adjacent lane, they shall be matched as nearly as possible by uniform transverse joints in the second lane. In the event uncontrolled cracks in the existing paved lane are too frequent or in random locations and impossible to match with a uniform spacing in the second lane, the two lanes shall be completely

separated by 3/4-inch joint Material along the length of the joint from 1/8 inch below the surface to one inch below the bottom of the concrete being placed.

Where integral curb or doweled curb is placed along the concrete pavement, premolded joint filler Material shall be placed transversely across the full section of the curb in true alignment with the pavement joint, perpendicular to the pavement grade.

All joints in an intersection shall be considered transverse joints except those joints that terminate normal to the curb radii.

5-05.3(8)D2 LONGITUDINAL JOINTS

Standard locations for longitudinal joints for the following pavement widths, whether contraction or construction, shall be in accordance with the following table unless specified otherwise in the Contract.

Width Curb to Curb	Joint Locations
25 Feet	Center line
32 Feet	Center line and 10 feet each side of center
36 Feet	Center line and 10 feet each side of center
40 Feet	Center line and 12 feet each side of center
44 Feet	Center line and 11 feet each side of center or match existing joint

In the event the roadway is divided into two lanes, the construction joints shall be located on the center line of the roadway. In separate lane construction, a joint filler 1/4-inch by 2 inches shall be placed between the two lanes when the second lane is constructed.

5-05.3(9) CASTINGS AND STEEL REINFORCING BARS IN CONCRETE PAVEMENT

Reinforcing steel bars shall be used to reinforce concrete pavement and rigid base around Standard Plan nos. 230 and 361 castings except when the casting crosses or is less than 18 inches near any pavement joint. A casting 18 or fewer inches clear from any pavement joint shall have 2 squares of steel reinforcement (rebar) placed around the casting at mid-depth of the concrete pavement slab. No. 4 rebar shall be used to form the 2 separate squares with the squares rotated 45 degrees from each other. The clearance of any rebar from the casting shall be a minimum of 2 inches to a maximum of 6 inches. Each set of 4 rebars shall have rebar length such that each bar is lapped at each end with connecting bars with 3 inch overlap. In no case shall any rebar be within 3 inches of any pavement joint.

See Section 7-20.3(1)C for temporary transition tapers around exposed castings.

5-05.3(10) TIE BARS AND DOWEL BARS

5-05.3(10)A DOWEL BARS

Dowel bars will be required in new pavement at all transverse joints of arterials, intersections, and bus and commercial non-arterials. The dowels shall be installed at the midpoint of the thickness of the pavement, parallel to the surface of the pavement and perpendicular to the transverse joint. The tolerances for placement shall be 6 1/8-inch. The size and spacing of dowel bars shall be as indicated on Standard Plan no. 405. The dowel bars shall be held in place during the placing and setting of the concrete. Dowel bars are not required between new pavement and existing pavement, unless otherwise indicated in the Contract. Joints normal to curb radii will not require dowel.

The dowels shall be installed by method of seating the dowels or by use of a dowel bar cage extended across the width of the transverse joint or by other methods approved by the Engineer. Dowel bars shall be coated with grease to prevent corrosion and dowel seizure. The grease coating on the dowel bars shall remain intact after installing and placing the concrete. Where dowel cages are used to support the dowels, the metal rod or wire ties used to hold the cage together during shipping shall be totally removed after the cage has been placed and secured to the base or subgrade and prior to the placement of the concrete Material.

5-05.3(10)B TIE BARS

Tie bars shall be placed at all longitudinal construction joints in accordance with Standard Plan no. 405. Tie bars are not normally required at longitudinal contraction joints or longitudinal joints between new and existing pavement unless otherwise indicated in the Contract. Tie bars shall be located at the required elevation and spacing shown on the Drawings and placed in such a manner that the vertical edge of the concrete is not deformed or damaged during placement of the bars. Joints normal to curb radii will not require dowel.

5-05.3(11) FINISHING

5-05.3(11)A GENERAL

The pavement shall be consolidated and the surface finished true to grade and cross-section by hand or machine finishing methods. On all vertical curves at irregular intersections, modified tools shall be provided as necessary to secure a smooth, uniform contour and surface.

5-05.3(11)B SLIP-FORM CONSTRUCTION

After the concrete has been given a preliminary finish by means of finishing devices incorporated in the slip-form paving equipment, the surface of the fresh concrete shall be checked by the Contractor with a straightedge device not less than 10 feet in length. High areas indicated by the straightedge device shall be removed by the hand-float method. Each successive check with the straightedge device shall lap the previous check path by at least 1/2 of the length of the straightedge. The requirements of this paragraph may be waived, upon the approval of the Engineer, if the Contractor can successfully demonstrate that other means can consistently produce a surface meeting the 10-foot straightedge requirement specified in Section 5-05.3(12).

Any edge slump of the pavement, exclusive of specified edging, in excess of 1/4 inch shall be corrected before the concrete has hardened. If edge slump on any 1 foot or greater length of hardened concrete exceeds 1 inch, the entire panel between the transverse and longitudinal joints shall be removed and replaced with concrete true to the specified line, grade, and cross-section.

High spots exceeding 1/4-inch shall be reduced by suitable grinding methods. Low spots exceeding 1/4-inch shall be filled with an epoxy-bonded grout. The Contractor shall submit to the Engineer for approval, the proposed epoxy grout and the method of applying the epoxy grout repair.

5-05.3(11)C STATIONARY SIDE FORM CONSTRUCTION**5-05.3(11)C1 HAND FINISHING**

After the concrete has been struck off and consolidated, it shall be smoothed by longitudinal floating. Movement ahead shall be in successive advances of not more than 1/2 the length of the float. Floating shall continue until all irregularities are removed. Longitudinal floating shall follow compaction of the concrete by not less than 30 feet. Free water on the pavement shall be removed with the float or other suitable tool. After floating, the surface shall be scraped with a grout rod at least 10 feet in length with a long handle for operating at the edge of the pavement. The grout rod shall be operated to correct irregularities in the pavement surface and remove water and laitance. Contraction joints shall be placed after all floating has been completed in accordance with provisions of Section 5-05.3(8)B2.

5-05.3(11)C2 MACHINE FINISHING

The finishing machine shall be of a type approved by the Engineer. The machine shall be adjustable to both crown and plane of the finished pavement surface. The screed shall oscillate longitudinally during its travel transversely across the pavement. It shall be operated in the forward direction so that the screed passes over the same section of pavement at least 2 times during its transverse travel.

The finishing machine shall be moved over the pavement as many times as is necessary to give the pavement a smooth even textured surface, conforming to the exact crown and cross section specified on the Drawings.

The floating shall not be considered complete until all free water is removed from the surface.

The finishing operations shall be performed at a time and over such lengths of the pavement surface as existing conditions necessitate.

5-05.3(11)D EDGING

Before the final finishing is completed and before the concrete has taken the final set, the pavement shall be edged as indicated in the following table:

Location	Radius
Edge of Pavement	1/2-inch
Contraction Joints	1/4-inch
Through or Construction Joints	1/2-inch

Particular attention shall be given to edge at the appropriate time. The concrete shall have attained a partial set and all free water shall have disappeared so that the edged joints are clearly defined with no tearing or slump of the edges.

5-05.3(11)E FINAL FINISH

After edging but prior to texturing, the Contractor shall demonstrate to the Engineer that the surface is ready for texturing by performing the surface smoothness checks as called for in Section 5-05.3(12). Any areas which do not comply with the specified tolerances shall be corrected and rechecked prior to texturing.

As the pavement surface is checked and approved for smoothness, the Contractor shall finish the surface with a uniform, gritty texture, true to grade and cross section. The final finish shall be accomplished by one of the methods described as follows to achieve the specified surface texture.

Before using either the drag, brush or comb, the concrete shall have set sufficiently so that the surface is not overgrooved or gouged in the finishing operation.

Burlap Finish: A burlap drag having at least 3 feet of drag in contact with the pavement and as wide as the pavement section shall be dragged forward over the pavement surface. The burlap drag shall be wet and clean when in use. The burlap shall not be left on the pavement surface between dragging operations.

Brush Finish: After edging, the pavement shall be brushed transversely with a fiber or wire brush of a type approved by the Engineer. The brush strokes shall be perpendicular to the center line with the adjacent strokes slightly overlapped. Care should be taken to make sure texture finish is uniform throughout the pavement surface.

Rough Finish: The Contractor shall give the pavement a final finish surface by texturing with a comb perpendicular to the center line of the pavement. The comb shall produce striations approximately 0.015 foot in depth at approximately 1/2-inch spacings in the fresh concrete. The comb shall be operated mechanically either singly or in gangs with several placed end to end. Finishing shall take place with the elements of the comb set at 45 degrees to the concrete surface to eliminate dragging the mortar. If the striation equipment has not been previously approved, a test section shall be constructed prior to approval of the equipment. If the pavement has a raised curb without a formed concrete gutter, the texturing shall end 2 feet from the curb line. This 2-foot untextured strip shall be hand finished with a steel trowel.

5-05.3(11)F UTILITY ADJUSTMENTS

Utility castings shall be adjusted to finished grade prior to the construction of the final wearing course (Section 7-20).

5-05.3(12) SURFACE SMOOTHNESS

The surface smoothness shall be checked with a straightedge 10 feet long, mounted to a long handle to permit operation from outside the pavement. The straightedge shall be placed on the surface of the pavement parallel to the centerline and at intervals of no more than 5 feet across the full width of the pavement so as to bridge any depressions and touch all high spots. Should the surface of the pavement, when tested with a 10 foot straightedge, vary from the true surface grade more than 1/8-inch in 10 feet on arterials, 1/4-inch in 10 feet on residential streets, 3/8-inch in 10 feet in alleys, 3/8-inch in 10 feet in concrete bases, and 1/8-inch in 10 feet in concrete bases for unit pavers, the Contractor shall correct the surface grade by redoing it's finish operation.

On projects with large amounts of concrete paving ("large" is defined as constructing 1000 linear feet of continuous concrete pavement), the pavement smoothness shall be checked under supervision of the Engineer following placement of concrete, with equipment furnished and operated by the Contractor. Smoothness of all pavement placed, except small or irregular areas, shall be measured with a recording profilograph (see Section 5-05.3(3) item 5) parallel to centerline, from which the profile index will be determined by the Engineer in accordance with WSDOT Test Method No. 807.

The transverse slope of the finished pavement shall be uniform to a degree such that no variation greater than 1/8-inch is present when tested with a 10 foot straightedge laid in a direction perpendicular to the centerline.

In no case shall the grade in the pavement or gutter be such that allows ponding of water. If the surface smoothness of the pavement after curing is found to exceed the tolerance permitted, the high spots shall be ground until they meet tolerance. If the surface tolerance cannot be met acceptably by grinding, the pavement shall be removed and replaced in conformity with the Specifications.

Only equipment and methods that consistently produce a finished surface meeting the requirements specified herein shall be used. Use of equipment or methods which do not meet these Standard Specifications shall be discontinued until the Contractor can revise and demonstrate changes in construction operations that meet the requirements of the Specifications.

If for any reason these surface smoothness checks are not performed, the Engineer may require the Contractor, as a condition of acceptance, to submit a report from a testing laboratory approved by the Engineer certifying that the surface smoothness complies with the specified tolerances, and that the testing laboratory is certified to do smoothness testing by either WSDOT or AASHTO.

5-05.3(13) CURING

5-05.3(13)A CURING PERIOD

Regardless of the curing method used, the Contractor shall maintain the curing protection and protect from damage from any cause for at least the length of time listed in the table that follows for the various mixes, exclusive of the day the concrete is placed, or until the pavement is opened to traffic, whichever comes first:

Type II Portland Cement Concrete Pavement	7 Days
High-Early-Strength Cement Concrete Pavement	5 Days
Concrete Mixes Containing Fly Ash	14 Days

5-05.3(13)B CURING METHODS

5-05.3(13)B1 GENERAL

Immediately after the finishing operations have been completed and as soon as marring of the concrete can not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the methods in the following subsections as the Contractor may elect.

Pavement edges which are exposed by the removal of the forms shall be protected by the immediate application of a curing medium of moist earth.

All curing Materials shall be free of all substances which are considered to be harmful to Portland cement. The curing medium shall be Capable of preventing checking, cracking, and dry spots regardless of conditions existing at the time of placement. Concrete placement will not be permitted unless curing Materials are on the Project Site and ready for immediate application. Failure to comply with all provisions of the curing procedures hereinafter specified will be sufficient reason to suspend all concrete operations.

When the curb section is to be placed separately, the surface of the pavement directly underneath the curb section shall be covered with a protective cover to protect that area from the curing agent when the pavement is sprayed.

5-05.3(13)B2 WHITE PIGMENTED CURING COMPOUND

White pigmented curing compound, meeting the requirements of Section 9-23.2, Type 2, Class B, shall be applied on the entire area of exposed surface of the new concrete with an approved mechanical spray machine. Wax base curing compound will not be allowed. The spray fog shall be protected from the wind with an adequate shield. It shall be applied uniformly at the rate of one gallon to not more than 150 square feet.

The curing compound shall be applied with equipment which ensures continuous agitation of the compound during spraying operations. The nozzle shall be of the two line type with sufficient air to properly atomize the compound.

The curing compound shall not be applied during or immediately after rainfall. If it becomes necessary to leave the pavement uncoated overnight, it shall be covered with polyethylene sheeting which shall remain in place until weather conditions are favorable for the application of the curing compound.

In the event that rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or in the event of damage to the film from any cause, the Contractor shall apply a new coat of curing compound in one or two applications to the affected area at the rate which results in a film of curing value equal to that specified in the original coat.

Containers of curing compound shall be distributed on concrete pavement in a manner to enable the Engineer to determine the rate of application being used at any time. All curing compound placed in the spray tanks shall be withdrawn directly from manufacturer's original containers bearing the manufacturer's name, brand, and lot number.

Curing compound shall be thoroughly agitated in accordance with the manufacturer's recommendations before placing in the tank. The compound shall not be diluted by the addition of solvents nor be altered in any manner. If the compound has become chilled to the extent that it is too viscous for proper stirring or application or if portions of the vehicle have been precipitated from solution, it shall be heated to restore proper fluidity but it shall not be heated above 100°F.

The curing compound shall be applied immediately after the concrete has been finished and after any bleed water that has collected on the surface has disappeared, or at a time designated by the Engineer. If hair checking develops in the pavement before finishing is completed, the Engineer may order the application of the curing compound at an earlier stage, in which event any concrete cut from the surface in finishing operations shall be removed entirely from the pavement. If additional mortar is then needed to fill torn areas, it shall be obtained ahead of the spraying operations. All areas cut by finishing tools subsequent to the application of the curing compound shall immediately be given new applications at the rate specified above.

The curing compound, after application, shall be protected by the Contractor from injury for the period of time specified above. All traffic shall be considered as injurious to the film of the applied compound.

The Contractor shall provide on the job a sufficient quantity of white polyethylene sheeting to cover all the pavement laid in three hours of maximum operation. This sheeting shall be reserved exclusively for the protection of the pavement in case of rain or breakdown of the spray equipment used for applying the curing compound. The protective sheeting shall be placed over the pavement in a manner approved by the Engineer.

Areas from which it is impossible to exclude traffic shall be protected by a covering of sand or earth not less than 1 foot in thickness or by other suitable and effective means. The protective covering shall be placed no earlier than 24 hours after application of the compound.

All liquid membrane-forming curing compounds shall be removed from the Portland cement concrete pavement to which traffic delineators are to be bonded. Curing compound removal shall not be started until the pavement has attained sufficient flexural strength for traffic to be allowed on it. The Contractor shall submit a proposed removal method to the Engineer and shall not begin the removal process until the Engineer has approved the removal method.

5-05.3(13)B3 WHITE POLYETHYLENE SHEETING

The sheeting shall be placed over the pavement immediately after finishing operations are completed, or at a time designated by the Engineer.

The sheeting shall be laid so that individual sheets overlap at least 2 feet, and the lapped areas shall be held in close contact with the pavement by weighting with earth or boards to prevent movement by the wind. The sheeting shall extend downward to cover the edges of the pavement and shall be secured to the subgrade with a continuous bank of earth or surfacing Material. Any holes occurring in the sheeting shall be patched immediately. The sheeting shall be maintained against injury and remain in place the minimum period of time as specified above.

White polyethylene sheeting shall conform to the requirements of Section 9-23.1.

5-05.3(13)B4 WET CURING

As an alternative to the above curing methods, the Contractor may wet cure the concrete pavement. Wet curing shall be accomplished by applying a continuous fog or mist spray to the entire pavement surface 24 hours a day for a

minimum of 7 days. If water runoff is not a concern, continuous sprinkling is acceptable. Sprinkling shall not begin until the concrete has achieved initial set as determined by AASHTO T 197 or other pre-approved method.

5-05.3(13)B5 TRANSPARENT CURING COMPOUND

The use of transparent liquid curing compounds shall be restricted to areas not exceeding 1,000 square yards.

The curing compound shall be Type 1D as specified in Section 9-23.2. Sufficient pigment shall be present so that the sprayed compound is easily discernible. The application and the curing shall be the same as for "White Liquid Membrane Curing Compound" in Section 5-05.3(13)B2.

5-05.3(13)B6 EMULSIFIED ASPHALT

Curing of concrete pavement when laid as a base for an asphalt wearing course shall comply with Section 5-05.3(20).

5-05.3(13)C CURING IN HOT WEATHER

In periods of low humidity, or drying winds, or high temperatures a fog spray shall be applied to concrete as soon after placement as conditions warrant in order to prevent the formation of shrinkage cracks. The spray shall be continued until conditions permit the application of a liquid curing membrane or other curing media. The Engineer shall make the decision when the use of a fog spray is necessary.

5-05.3(14) COLD WEATHER WORK

When the air temperature is expected to reach the freezing point during the day or night and the pavement has not cured for 50 percent of the time specified in Section 5-05.3(13)A, the concrete shall be protected from freezing. The Contractor shall, at no expense to the Owner, provide a sufficient supply of straw, hay, grass, earth, blankets, or other suitable insulating blanket material and spread it over the pavement to a sufficient depth to prevent freezing of the concrete. The Contractor shall be responsible for the quality and strength of the concrete thus cured. Any concrete injured by frost action or freezing shall be removed and replaced.

5-05.3(15) CONCRETE PAVEMENT CONSTRUCTION IN ADJACENT LANES

Refer to Section 5-05.3(7)A.

5-05.3(16) PROTECTION OF PAVEMENT

The Contractor shall protect the pavement and its appurtenances from any damage. Protection shall include personnel to direct traffic and the erection and maintenance of warning signs, lights, barricades, temporary take-down bridges across the pavement with adequate approaches, and whatever other means may be necessary to accommodate local traffic and to protect the pavement during the curing period or until opened to traffic as specified in Section 5-05.3(17). Also see Sections 1-07.23 and 1-10.

5-05.3(17) OPENING PAVEMENTS TO TRAFFIC

The Contractor shall not open newly constructed cement concrete pavement to traffic, including construction equipment, until the pavement has cured for the period of time specified in Section 5-05.3(13)A and has attained the required compressive strength. Approval to open newly constructed pavement to the use of construction equipment (or other traffic) in less time than the time period specified in Section 5-05.3(13)A will be limited to those paving situations when the Contractor is unable to use the subgrade or base course of the lane being paved, or the shoulder adjacent to it, for paving equipment.

Approval will be conditioned upon the Contractor agreeing to the following restrictions:

1. The concrete in the newly paved lane has attained a flexural strength of 500 psi as determined with a Beam Test pursuant to AASHTO T 177 or ASTM C 293.
2. The Beam Test is performed at the Contractor's expense by an independent materials laboratory retained by the Contractor. The laboratory retained by the Contractor shall be a laboratory accredited by a recognized standards organization and be acceptable to the Engineer.
3. The surface of the new pavement shall be protected from scarring and abrasion by operating mixers, trucks, and other construction equipment on mats, skids, or other protective devices approved by the Engineer. Accumulation of sand, gravel, dirt, concrete or other debris deposited on the new pavement shall be removed daily. Curing compound protection damaged as a result of using the paved lane shall be replaced concurrent with spraying of curing compound on the newly placed concrete.
4. The Contractor shall remove and replace at no expense to the City any panels on the new pavement that are cracked or broken as a result of the Contractor's early opening of the lane to traffic.

Streets with curbs shall not be opened until the curb has cured for at least 72 hours and has attained 2500 psi strength. If the curb has not attained the above-mentioned 2500 pounds per square inch strength, the Contractor shall protect the curb by placing form lumber on the pavement 2 feet away from the curb, or standard barricades and maintain them (see Sections 1-07.23 and 1-10). Such curb protection shall remain in place as long as may be necessary for protection of the curb. See Section 8-04.3(1)E for concrete curb curing requirements.

Streets shall not be opened to traffic until the smoothness criteria specified in Section 5-05.3(12) have been verified by the Engineer.

Temporary pavement markings shall be installed, maintained, and subsequently removed in accordance with Sections 1-07.23(1) and 1-10.3(4)C.

Prior to opening for traffic, the Contractor shall clean the pavement. The Engineer will determine when the pavement is ready for traffic.

5-05.3(18) CEMENT CONCRETE APPROACHES

Concrete approaches shall be constructed at the locations shown on the Drawings or as staked by the Engineer and in accordance with WSDOT Standard Plan no. F4.

Concrete approach construction shall comply with the provisions of Section 5-05. In addition, placing, compacting, and finishing concrete approaches may be by hand methods as approved by the Engineer.

5-05.3(19) REINFORCED CONCRETE BRIDGE APPROACH SLABS

Approach slab concrete shall conform to the requirements of Section 6-02.3.

Reinforced concrete bridge approach slabs shall be constructed at the locations shown on the Drawings or as staked by the Engineer and in accordance with the Contract.

The approach slabs shall be constructed full bridge deck width from outside usable shoulder to outside usable shoulder at an elevation to match the Structure. Pavement ends and the bridge ends of the approach slabs shall be modified as shown on the Drawings to accommodate the grate inlets at the bridge ends if the grate inlets are required.

Screed rail support, installation, and finish machine requirements shall be as specified for bridge deck slabs.

Reinforced concrete bridge approach slab anchors shall be installed as detailed on the Drawings. For Method A anchor installations, the grout or adhesive used to install the anchors shall have a minimum compressive strength of 4000 psi at three days and be Capable of developing the ultimate strength of the anchor rod. The anchor rod shall be ASTM A 36 steel. Compressive strength shall be determined in accordance with AASHTO T 106. The anchors shall be installed parallel both to profile grade and center line of roadway. The Contractor shall secure the anchors to ensure that they do not become misaligned during concrete placement.

The compression seal shall be as noted in the Contract (see Section 6-02.3(13)B).

Finishing of the reinforced concrete bridge approach slabs shall be accomplished by either a combination of finishing machine and hand finishing or by hand finishing methods only. The finished and cured approach slabs shall be free from any deviation exceeding 1/8 inch under a 10-foot straightedge placed parallel and perpendicular to the center line of the roadway.

5-05.3(20) UNFINISHED CEMENT CONCRETE PAVEMENT

Cement concrete pavement that is intended as a base for an asphalt wearing course, shall conform to all requirements of Section 5-05 with the following exceptions:

1. The surface tolerance shall be 3/8 inch in 10 feet.
2. The surface of the concrete base, if hand compacted, may be struck off with only one strike-off rod.
3. Contraction joints shall be constructed as follows:
 - a. A weakened plane shall be made in the plastic concrete every 15 feet or to match existing cracks as designated by the Engineer;
 - b. The plane shall be weakened with a joint cutter to a minimum depth of 2 inches;
 - c. Bulging caused by the joint cutter shall be corrected by floating lightly; and
 - d. Joint Material shall be placed completely through the curb at the point where the weakened plane intersects the curb.
4. Liquid curing compounds which leave a waxy film on the concrete shall not be used for curing concrete base pavement. If cured with a liquid curing compound, it shall meet the requirements of Section 9-23.2 for the clear type and the rate of coverage shall be at least one gallon per 125 square feet; or emulsified asphalt CSS-1 or CRS-1 meeting the requirements of Section 9-02.1(6) applied at a rate between 0.15 gallon and 0.25 gallon per square yard of surface.

5-05.3(21) SIDE FORMS

Side forms shall have a height of not less than the specified depth of pavement, and thickened edge when applicable, and shall be of ample strength to resist deformation. They shall be provided with adequate devices for secure setting so that when in place they shall withstand, without visible springing or settlement, the weight, impact, and vibration of the finishing machines. The forms shall be free from warps, bends, or kinks.

Forms shall be drilled in advance for tie bar placement to line and grade where tie bars are specified.

Forms shall remain in place at least 12 hours after the concrete has been placed and shall be cleaned and oiled each time they are used. Curing compound shall be applied to the concrete immediately after the forms are removed.

The alignment and grade elevations of the forms shall be checked and the necessary corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any subgrade thereunder has become unstable, the form shall be reset and rechecked.

Forms may be of wood or metal or any other material at the option of the Contractor, provided the forms as constructed result in a pavement of specified thickness, cross section, grade, and alignment as shown on the Drawings.

Forms shall be adequately supported to prevent deflection or movement, and result in concrete pavement conforming with the Contract. The top of the forms shall not deviate more than 1/8-inch in 10 feet and the alignment of forms shall be within 1/4-inch in 10 feet. The forms may be removed the day after pouring if the concrete is sufficiently set to withstand removal without danger of chipping or spalling. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with moist earth or sprayed with curing compound. All forms shall be cleaned, oiled and examined for defects before they are used again.

5-05.3(22) REPAIR OR REPLACEMENT OF DEFECTIVE PAVEMENT PANELS

5-05.3(22)A GENERAL

Damage to new and existing concrete pavement caused by Contractor operations or by defective and unauthorized work (i.e. broken panels, cracks, nonworking joints, spalls, etc.) shall be addressed in accordance with Section 1-05.7.

5-05.3(22)B CRACK RESTORATION

Pavement slab containing more than one crack shall be removed and replaced in its entirety.

Prior to joint sealing, pavement slab containing a single crack shall be removed and replaced such that the minimum dimension of the removed slab is six (6) feet long and full panel width. The portion of panel to remain in place shall have a minimum dimension of six (6) feet in length and full panel width, otherwise the entire panel shall be replaced. There shall be no new joints closer than three (3) feet to an existing transverse joint. Saw cutting full pavement depth is required along all longitudinal joints and at transverse locations. Tie bars and dowel bars shall be used in accordance with Section 5-05.3(10).

5-05.3(22)C SPALL AND EDGE SLUMPING RESTORATION

Spalls and edge slumping shall be repaired by making vertical saw cuts at least three (3) inches outside the affected area and to a minimum depth of three (3) inches. Repair depths that exceed one third of the total slab depth or encounter dowel bars or reinforced steel will require full depth repair. When the affected area is directly against a longitudinal or transverse joint, a debonding medium (compressible joint insert or polyethylene strip) shall be placed between the existing concrete and the area to be patched. For transverse joints, the compressible joint material shall be placed into the existing joint one (1) inch below the depth of the repair and extended at least three (3) inches beyond each end of the patch boundaries. If the affected area is directly against an asphalt pavement, a formed edge even with the surface is required. The concrete in the affected area shall be chipped out to sound concrete with a pneumatic hammer with a maximum weight of 30 pounds. The formed cavity shall be sand blasted thoroughly clean and all loose material removed. Where required, an epoxy bonding agent shall be applied fully covering the dry cleaned surface of the cavity with a thin even coat. Placement of Portland cement concrete or epoxy concrete or mortar shall immediately follow the application of the epoxy bonding agent. The epoxy bonding agent shall meet the requirements of Section 9-26 for Type II epoxy (Portland cement concrete placement) or Type III epoxy (epoxy concrete or mortar placement). Low areas which grinding cannot feasibly remedy, shall be sandblasted, filled with epoxy bonding mortar, and textured by grinding. The epoxy bonding agent shall meet the requirements of Section 9-26 for Type II epoxy. The patch mixture shall be placed and vibrated to eliminate any voids. Vibrators greater than one (1) inch shall not be used. If cementitious repair material is used, the patch perimeter shall be sealed with a 1:1 cement:water grout. The patch mixture shall be cured according to the manufacturer's recommendation.

5-05.3(23) CEMENT CONCRETE PAVEMENT FOR ALLEY

5-05.3(23)A PAVEMENT AND ALLEY REQUIREMENTS

Cement concrete pavement for alleys shall meet the requirements of Section 5-05 and Standard Plan no. 403. Alleys shall meet the requirements for driveways in Section 8-19.

5-05.3(23)B EXTRA CONCRETE FOR ALLEY APPROACH RAMP

When constructing and finishing cement concrete alley pavement, the Engineer may in some cases require the Contractor to place additional concrete over the surface of the alley pavement to serve as an integral ramp or vehicular access to abutting private property. Such extra concrete shall be placed and finished to the additional thickness directed by the Engineer. Additional thickness for such ramps shall not exceed 6 inches above the original planned concrete surface at any point, and will be addressed in accordance with Section 1-04.4. See Standard Plan no. 430.

5-05.3(23)C CURB WALL AND SUPPORT WALL

5-05.3(23)C1 GENERAL

Where shown on the Drawings, the Contractor shall construct the curb wall, and either the edge wall or support wall as shown on Standard Plan no. 403. The alley width indicated on the Drawings shall be taken to the face of the curb and as shown on Standard Plan no. 403.

After removal of forms, all lips and edgings shall be removed. Bolts or concrete ties shall be removed and the holes filled with 1:2 mortar and floated to an even uniform surface. If in the opinion of the Engineer an acceptable surface has been obtained, no further finishing shall be done. If, however, the surface is unacceptable, these surfaces shall be thoroughly washed with water and a 1:1 mortar applied with brush and completely worked into the small air holes and other crevices. After initial set, the surface shall be rubbed with a damp sack.

5-05.3(23)C2 CURB WALL

Curb wall shall be constructed as indicated on Standard Plan no. 801.

5-05.3(23)C3 SUPPORT WALL

Support wall shall be constructed as indicated on Standard Plan no. 800.

5-05.3(24) CONCRETE UNDERPINNING

Where designated by the Engineer, existing concrete foundations left above grade shall be supported with concrete underpinning.

5-05.3(25) WATER

Water for pavement construction shall be furnished as provided in Section 2-07 (also see Section 9-25.1).

5-05.3(26) PAVEMENT PATCHING**5-05.3(26)A GENERAL**

Concrete pavement restoration shall be considered "Pavement Patch" when due to a trench cut and the width of the opening is less than the full concrete panel width. Concrete pavement patching shall be scheduled to accommodate the demands of traffic, and shall be performed as rapidly as possible to accommodate public travel.

The placing and compaction of the trench backfill shall be in accordance with the applicable Sections of Division 7 and Division 8, and the preparation and compaction of the subgrade shall be in accordance with Section 2-06.

Before applying the patch, all pavement cuts shall be trued so that the cut edges of pavement form a rectangle with straight edges and vertical faces. The use of a concrete saw will be required for Portland cement concrete pavement as specified in Section 2-02.3(6). Line drilling will be allowed for asphalt overlaid Portland cement rigid pavement base.

Cement concrete pavement patch shall be the class of concrete specified in Section 5-05.2. Curing compound shall be as specified in Section 5-05.3(13).

Signing, barricades, lights and other warning devices shall be as specified in Sections 1-07.23 and 1-10 and shall be maintained until the patch is completed and ready for traffic.

5-05.3(26)B CEMENT CONCRETE PAVEMENT

Streets which have rigid type pavements surfaced with asphalt concrete shall be patched as shown on Standard Plan nos. 404a and 404b. The thickness of concrete pavement patch shall match the existing rigid base or 9 inches, whichever is greater. The top surface of the concrete shall match the top surface of the existing rigid base; in no case shall the top of the concrete be higher than the top of the existing rigid base. Brush finishing will not be required. Joints shall be placed to match existing joints. Curing shall be accomplished with STE-1 asphalt emulsion diluted with water.

When the existing street surface is cement concrete, the concrete pavement patch shall be placed, compacted, and struck off to the grade of the adjacent pavement. Through joints and dummy joints shall be placed and edged to match existing joints. The surface shall be finished and brushed with a fiber brush or combs or tines. Approved curing compound shall be placed on the finished concrete immediately after finishing.

5-05.3(27) TEMPORARY PAVEMENT PATCHING

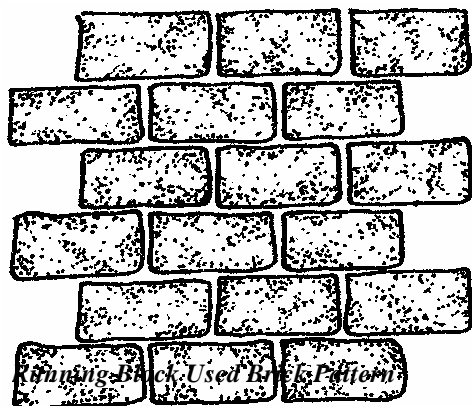
Temporary pavement patching shall be in accordance with Section 5-04.3(23).

5-05.3(28) CASTINGS IN CONCRETE PAVEMENT

See Sections 5-05.3(9) and 7-20.

5-05.3(29) STAMPED CONCRETE SURFACE TREATMENT

Stamped concrete surface treatment is defined as additional work necessary to imprint concrete pavement,



while concrete is still in a plastic stage, with a "running bond used brick" pattern. The Contractor shall refer to the sketch on the left for pattern details. Nominal size for a typical brick shall be 8 inches long by 4 inches wide. The long edge of brick shall be laid perpendicular to the crosswalk. All work shall be installed by a licensed contractor and supervised by a foreman who has completed at least three prior installations of stamped concrete. All work shall comply with the specification and quality standards issued by the supplier of the imprinting tools.

No stamped concrete work shall begin until the Engineer gives this direction. The concrete shall be placed and screed to the finished grade and floated to a uniform surface. The Contractor shall use the required imprinting tools to apply the desired impressions to the crosswalk surfacing while the concrete is still in the plastic stage of set. After initial curing, the surface impressions shall be grouted when required.

5-05.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for pavement or pavement base will be by the square yard of concrete in place, including the area placed underneath curbs. No deduction will be made for castings in pavement.

Measurement for thickened edge will be by the linear foot as measured along the thicker face of the thickened edge.

Measurement for concrete underpinning will be by cubic yard placed as computed by the Engineer.

Measurement for edge wall, support wall and curb wall will be per cubic yard of concrete based on neat lines indicated on Standard Plan nos. 403, 800, and 801.

Steel required for pavement reinforcement (Section 5-05.3(7)E) will be measured by the pound of rebar in place.

Tiebars and dowels required for pavement and curbs, and reinforcing steel for castings will not be measured.

Measurement for curb constructed with alley pavement will be in accordance with Section 8-04.

Measurement for Stamped Concrete Surface Treatment will be per square yard.

Measurement of concrete pavement patching will be by the cubic yard for cement concrete patching. Quantities for surface restorations for trench excavations, other than for electrical conduit trench as specified in Section 5-04.4, will be based upon computations made by the Engineer using the required pavement patch thickness and the removal criteria specified in Section 2-02.3(3). Concrete pavement restoration requiring full concrete pavement panel replacement will be measured as pavement or pavement base as specified in this Section.

5-05.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-05 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Pavement, Cement Concrete (Class), (Thickness)",** per square yard.

2. **"Pavement Base, Cement Concrete (Class), (Thickness)",** per square yard.

The Bid item prices for "Pavement, Cement Concrete (Class), (Thickness)" and for "Pavement Base, Cement Concrete (Class) (Thickness)" shall include all costs for the work required to furnish and install concrete pavement as indicated in the Contract.

3. **"Pavement, Thickened Edge (18 inch x 3 inch)",** per linear foot.

The Bid item price for "Pavement, Thickened Edge (18 inch x 3 inch)" shall include all costs for the work required to shape and compact the subgrade for the thickened edge including the concrete.

4. **"Underpinning, Cement Concrete CL 5 (3/4)",** per cubic yard.

The Bid item price for "Underpinning, Cement Concrete CL 5 (3/4)" shall include all costs for the work required to furnish and place the underpinning and reinforcing steel including as needed excavation.

5. **"Wall, Cement Concrete, Edge, Type 403",** per cubic yard.

The Bid item price for "Wall, Cement Concrete, Edge, Type 403" shall include all costs for the work required to construct the edge wall as shown on Standard Plan 403 including but not limited to excavation and disposal.

6. **"Wall, Cement Concrete, Support, Type 800",** per cubic yard.

The Bid item price for "Wall, Cement Concrete, Support, Type 800" shall include all costs for the work required to construct the wall as shown on Standard Plan no. 800. Payment for excavation, for disposal of materials, and for reinforcing steel (including steel extending into pavement slab) for the support wall shall be considered included in the Bid item price.

7. **"Wall, Cement Concrete, Curb, Type 801",** per cubic yard.

The Bid item price for "Wall, Cement Concrete, Curb, Type 801" (including reinforcing steel extending into pavement slab) shall include all costs for the work required to construct the wall as shown on Standard Plan no. 801. Payment for excavation, for disposal of materials, and for reinforcing steel for curb wall shall be considered included in the Bid item price.

8. **"Pavement Patch, Cement Concrete Class 6.5 (1-1/2), H.E.S.",** per cubic yard.

The Bid item price for "Pavement Patch, Cement Concrete Class 6.5 (1-1/2), H.E.S." shall include the costs for the work not otherwise provided for in Section 5-05.5 but necessary to maintain and permanently restore, as applicable, pavements or other traffic bearing surfaces which have been opened by trench excavation or similar work. All incidental work required to complete the patching of street surfaces, including installing joints where required, shall be considered incidental to this Bid item.

9. **"Stamped Concrete Surface Treatment",** per square yard.

The Bid item price for "Stamped Concrete Surface Treatment", shall include all costs for the work necessary to install the specified textured pavement treatment complete in-place, including but not limited to release agents, admixtures, imprinting tools, grouting material, finishes and edge finishes, as specified in Section 5-05.3(24), and as necessary.

Payment for concrete pavement shall be paid separately in accordance with this Section.

10. **Other payment information**

Payment for roadway ballast and crushed rock surfacing will be as "Mineral Aggregate, (Type)" per Section 4-01.5.

All costs in connection with replacing Portland cement with fly ash as specified shall be included in the Bid item price for the various classes of concrete involved. If the concrete is to be paid for other than by class of concrete, all costs involved with replacing Portland cement with fly ash as specified shall be included in the Bid item price for the applicable Bid item.

All costs required to furnish and mix additional Portland cement to concrete as specified in Section 9-01.4; to repair defective pavement slab as specified in Section 5-05.3(22); and to repair new pavement injured by frost action shall be considered defective work and will be paid in accordance with Section 1-05.7.

Cost for temporary pavement marking, Section 5-05.3(17), shall be considered incidental to the pavement Bid item.

Payment for backfill and compaction of trench subgrade shall be included in the Bid item price for the trench Bid item.

Payment for steel reinforcing bar for reinforced concrete pavement and for bridge approach slab will be paid separately in accordance with Section 6-02.5.

Steel required for tiebars, dowels, curbs and pavement, and for reinforcement around castings will be considered included in the Bid item price of the pavement Bid item and no separate or additional payment will be made.

Payment for "Pavement Patch, Temporary" will be in accordance with Section 5-04.5

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